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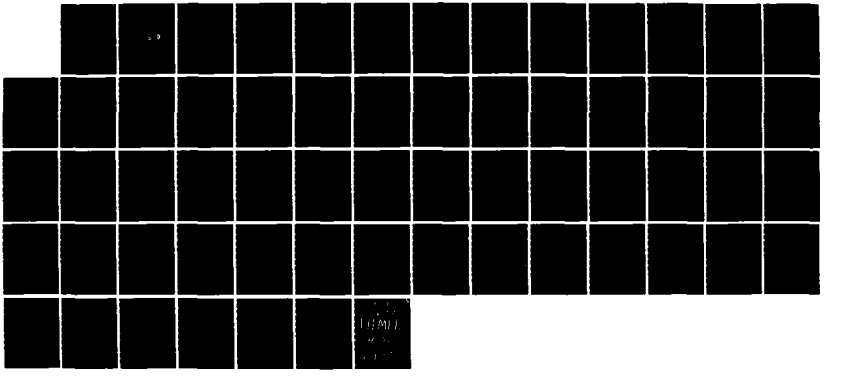

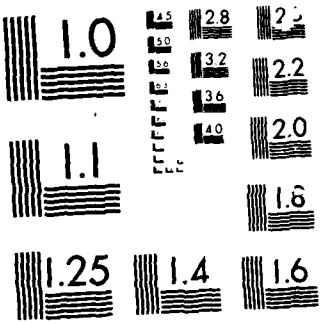

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COMBINED DIRECT/INVERSE THREE DIMENSIONAL TRANSONIC WING DESIGN WITH VISCOUS AND WING/BODY EFFECTS

VOLUME 2 : USERS GUIDE FOR ANALYSIS/DESIGN COMPUTER PROGRAM

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Aug. 1984
~~February 1986~~

Final Report for Period January 1983 to August 1984

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This Users Guide describes the input and operation requirements of a computer code for the analysis and design of wings in transonic flow. A synopsis of the function of the major subroutines in the program is given in addition to a detailed description of the input variables required to run the code. Sample data sets are presented that illustrate the data sequence required for various code options.

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ABSTRACT

This users guide describes the input and operation requirements of a computer code for the analysis and design of wings in transonic flow. A synopsis of the function of the major subroutines in the program is given in addition to a detailed description of the input variables required to run the code. Sample data sets are presented that illustrate the data sequence required for various code options.

ADMINISTRATIVE INFORMATION

The work presented was a joint effort by Lockheed-Georgia Company and Texas A&M University supported by the Naval Air Systems Command under the cognizance of D. G. Kirkpatrick (NAVAIR-311D AIRTASK WR02302), Navy Contract N00167-81-C-0078-P00004. The authors acknowledges the support of Dr. Tsze C. Tai, contract monitor at David Taylor Ship/Research and Development Center during all phases of this research.

INTRODUCTION

This users guide describes the inputs required to run the Lockheed-Georgia Direct/Inverse Design Code (ZEBINV) in the analysis and design modes. The following sections include a brief description of how the code works, a detailed description of the required input data, along with sample input decks and an example of the typical output from the code.

DESCRIPTION OF CODE OPERATION

In the analysis mode, the Lockheed Georgia Direct/Inverse Design Code (ZEBINV) computes the inviscid potential flow about three-dimensional wings using the ZEBRA II algorithm developed by South et al[1]. The conservative full potential equation is solved on a stretched Cartesian grid that is sheared to align with the leading and trailing edges of the wing.

A typical analysis run begins with the inputting of data that define the airfoil geometry at different spanwise control stations, the wing planform geometry, mesh generation parameters, flow solver initialization and control

parameters. Subroutines SECTIN and INPUT control the reading in of all analysis data. After the required data has been input,the program calls routines to generate the computational grid (SETUP) and compute initial flow parameters (INIT). Subroutine ZEBRA is then called to generate the potential flow solution. ZEBRA calls subroutine WNGBC2 to compute and update both wing surface and outer grid boundary condition, subroutine RO to compute the density at grid half points, and subroutine ROCOZ to compute the retarded density coefficients used in the potential flow solver. Subroutine OUTPUT is called at the end of the solution to compute and print output parameters.

When viscous analysis or design is selected, subroutine VISACT is called from ZEBRA to compute the displacement thickness due to the boundary layer and to update the surface boundary conditions to account for the viscous effects. A second viscous flow routine BDLY is called to compute viscous effects during inverse design cases.

Wing/body effects are computed in subroutine WONZ which is called by INIT. WONZ is called prior to the start of the potential flow solution for each grid of a grid sequencing run.

During inverse design cases, two subroutines are called to compute the current wing shape and perform a wing reloft to enforce a desired trailing edge thickness. These subroutines are SHAPE and RELOFT. When relofting is in effect SHAPE is called by RELOFT. RELOFT is called from subroutine ZEBRA at a specified iteration frequency.

The sequencing of the input routines, flow solver, and output routines is controlled by the main program ZEBINV. This program contains logic that allows grid sequencing to be used to speed up the flow solution. The sample data sets presented in the following sections illustrate the use of a sequence of three grids in the flow solution.

DETAILED DESCRIPTION OF INPUT

The input data set required by the analysis/design code can be

broken into five distinct types of data. These data types are:

1. Airfoil section ordinates at specified span locations
2. Data to define the wing planform
3. Control parameters for mesh generation and solution initial
4. Wing/Body data
5. Inverse design data

Each different type of data will be described separately. The input be described card by card. This description will contain both definition of the input variable and the input format.

A. Airfoil Section Inputs and Test Case Title

Section ordinates can be defined at up to 11 span locations of the airfoil section ordinates are:

1. TITLE1, TITLE2, ATITLE (3 cards, 8A10)

TITLE1 - Two card test case title and description that

TITLE2 is written to output files.

ATITLE - Airfoil data description.

2. NPAN, INU, INL, KSMTHS (1 card, 8I10)

NPAN - Number of span stations at which airfoil ordinates are to be defined - at least two stations are required (2.LE.NPAN.LE.11)

INU = Number of upper surface airfoil ordinates. Must be the same for all sections .LE. 100.

INL = Number of lower surface airfoil ordinates. Must be

the same for all sections .LE. 100.

KSMTHS = Number of times computed surface slopes are smoothed.

3. XINU(I), I = 1, INU (INU/8 Cards, 8F10.0) x/c at which airfoil upper surface ordinates are input for the wing section.

4. XINL(I), I = 1, INL (INL/8 Cards, 8F10.0) x/c at which airfoil lower surface ordinates are input for the wing section.

5. ZUP(I, 1), I = 1, INU (INU/8 Cards, 8F10.0) upper surface airfoil ordinates (Z/C) at wing root.

6. ZLP(I, 1) I = 1, INL (INL/8 Cards, 8F10.0) lower surface airfoil ordinates at the wing root station.

The airfoil sections at span stations 2 through NPAN are defined by the following sequence of cards.

7. ISAMX, ISAMZ (1 Card, 2L5).

ISAMX = T ordinates will be defined at the x/c locations of the root section.

= F new x/c locations will be input. The corresponding z/c ordinates will then be splined onto the root X/C locations.

ISAMZ = T use ordinates for previously defined station.
= F input new z/c ordinates.

8. If ISAMX = T AND ISAMZ = F, repeat cards 5 and 6 after 7.

9. If ISAMX = F and ISAMZ = F, repeat cards 3 through 6 after card 7.

10. To use airfoil section defined at station N-1 at station N, repeat card 7 with ISAMX = T and ISAMZ = T.

Planform Geometry

1. Header (2X)

2. PTITLE (1 Card, 8A10)

   80 character wing planform description

3. YROOT, XLER, XTER, YTIP, XLET, XTET, SREF, CREF, XMON (2 Cards, 6F10.0)

   These variables define trapezoidal reference wing:

   YROOT = Y coordinate of root
   XLER = X coordinate of L.E. at root
   XTER = X coordinate of T.E. at root
   YTIP = Y coordinate of tip
   XLET = X coordinate of L.E. at tip
   XTET = X coordinate of T.E. at tip
   SREF = Wing reference area (Semi Span Area)
   CREF = Reference chord
   XMON = Moment reference

4. NLES (1 Card, 8I10)

   NLES - Number of segments input to describe the leading edge (NLES.LE.3).

5. NLEI (1 Card, 8I10)

   NLEI = Number of Y,X pairs defining leading edge (NLEI.LE.10).

6. YLEI(I),XLEI(I),I=1,NLEI (NLEI/4 Cards, 8F10.0)

YLEI,XLEI = Y,X pairs defining the leading edge segment

At least two pairs required.

Same dimensional system as XLER, etc.

7. DXLER,DXLET (1 Card, 8F10.0).

DXLER = DX/DY of L.E. at inboard edge of segment

DXLET = DX/DY of L.E. at outboard edge of segment

Note: Repeat cards 5 through 7 NLES times

8. NTES (1 Card, 8I10)

NTES = Number of segments input to describe the trailing edge (NTES.LE.3)

9. NTEI (1 Card, 8I10)

NTEI = Number of Y,X pairs defining trailing edge segment

(NTEI.LE.10).

10. YTEI(1),XTEI(1),I=1,NTEI (NTEI/4 Cards, 8F10.0)

YTEI,XTEI = Y,X pairs defining the trailing edge segment

At least two pairs required

11. DXTER,DXTET (1 Card, 8F10.0)

DXTER = DX/DY of T.E. at inboard edge of segment

DXTET = DX/DY of T.E. at outboard edge of segment

NOTE: Repeat cards 9 through 11 NTES times

12. YP(N),THETP(N),N=1,NPAN (NPAN/4 Cards, 8F10.0)

YP = Fraction of semispan at which airfoils are defined

THETP = Twist Angle, degrees, at YP - Positive if leading edge is up

C. Mesh Generation and Solution Parameters

A set of five namelists are used to input values that control mesh generation, solution initialization and solution sequencing. Namelist GPARM, XGRID, YGRID, and ZGRID are used in mesh generation. Namelist SOLVIN is used to put flow solver parameters. A sixth namelist VISCDT is input after SOLVIN if IVISC = 1 in SOLVIN. This set of namelists must be input for each grid in a grid sequencing run; however, only those values that change from grid to grid must be redefined. The namelists and the input parameters required for analysis runs are:

1. TITLEM (1 Card, 8A10)
   Namelist set description

2. GPARM (Namelist input - Default values in parenthesis)

   IPRNTG = 1 - Prints computational grid (0)

   WBCPRT = .T. - Prints upper and lower surface slopes at each spanwise grid station (.F.)

NTIPLE = 1 - Generates a constant chord tip extension with tip section sweep from wing tip to outer boundary

3. XGRID (Namelist input)

NXON - Number of streamwise mesh points on wing surface at each span station

NXFWD- Number of streamwise mesh points ahead of the wing leading edge

NXAFT- Number of streamwise mesh points aft of the wing trailing edge

XPLE - Grid stretching factor for grid in front of wing; computed in MESHZ for XFWD .NE.0

XPTE - Grid stretching factor for grid behind wing; computed in MESHZ for XAFT .NE.0

XFWD - Desired location of the upstream boundary referenced to the leading edge of the wing (in root chords).

XAFT - Desired location of the downstream boundary referenced to the leading edge of the wing (in root chords).

4. YGRID (Namelist input)

NYON - Number of spanwise grid points on wing surface

NYOFF- Number of spanwise grid points off of the wing surface

YPTIP- Grid stretching factor for grid beyond wing tip, computed in MESHZ when YMAX .NE.0

YMAX - Desired location of the spanwise outer boundary referenced to the wing tip (in semi-spans). For example, YMAX=1.3 places the spanwise boundary at 1.3 semi-spans beyond the wing tip.

5. ZGRID (Namelist input)

NZ - Number of vertical grid points

ZP - Grid stretching factor for vertical direction. The grid is stretched equally above and below the z = 0 plane. Computed in MESHZ when ZMAX .NE.0

ZMAX - Desired location of the top and bottom boundaries of the computational plane (in root chords).

6. SOLVIN (Namelist input)

MACH - Free-stream Mach number for test case

AOA - Wing angle of attack in degrees

OMEGX
OMEGY- Relaxation parameters for the x, y, and z directions
OMEGZ

OMEGG- Relaxation factor for circulation

MAXIT- Maximum number of iterations of the flow solver

RCONV- Convergence tolerence = the ratio of current maximum residual and initial residual

NGSEQ- Number of grids to be used in grid sequencing runs

IPRINT = 1 - Calls output to print flow solution parameters

IPLOT = 1 - Writes plot data to a specified logical unit for post-processing

IVISC = 1 - Selects viscous analysis/design mode

IFUSE = 1 - Turn on wind body effects with circular cylinder fuselage

= 2 - Turn on wing body effects using input fuselage cross-sections

ICIRPF - Spanwise circulation distribution print frequency
Prints every ICIRPF iterations

IKLUNK = 1 - Updates outer boundary potentials using Klunkers expressions

= 0 - Sets outer boundary potentials to zero

IPU - Logical unit to which plot data will be written

IINV = 1 - Perform inverse design

IDESN = 1 - Design both upper and lower surfaces
= 2 - Design upper surface only
= 3 - Design lower surface only

IRLOFT = 1 - Start wing relofting for trailing edge closure on initial grid for NGSEQ.NE.0

= 2 - Start wing relofting for trailing edge closure on second grid for NGSEQ.NE.0.

= 3 - Start wing relofting for trailing edge closure on third grid for NGSEQ.NE.0.

NF - Number of fuselage control points used to evaluate wing/body effects (50 or less)

NITRL - Perform NITRL iterations before first wing reloft

NITRF - Reloft wing every NITRF iterations

NJSHP - Print relofted data every NJSHP span stations

NITDSN - Perform NITDSN iterations prior to start of inverse design

ILED - Initial chordwise index to begin inverse design

ITED - Trailing edge index

ISVSHP - Save inverse shapes at end of run

IRSTRT - Restart from previous run

ISRLOR - Save relofted ordinates for restart runs

IPRSHP - Print relofted shapes

7. VISCDT (Namelist input) - only if IVISC .NE. 0 in SOLVIN

RN - Reynolds number based on root chord

DELCOR - Square of the cosine of an appropriate sweep angle such as the mid-chord used to modify boundary layer calculation for 3D effects

NVISC - Number of potential flow solver iterations prior to first viscous update

ITR - Updates viscous corrections every ITR iterations after first update

NPRV - Print viscous flow information every NPRV iterations

NJPRV - Print viscous information every NJPRV span stations

XIBDLY - X/C location of transition point for both upper and lower surfaces

XSEP - X/C location before which the seperation parameter, SEP, is restricted to a maximum value of 0.004. After XSEP, SEP can have any value

XPCI - Lower surface X/C location after which a decreasing lower surface displacement thickness is forced to continue decreasing

D. Wing/body Data

The format of the wing/body data depends on the value of IFUSE entered in namelist SOLVIN. If IFUSE = 1, the fuselage is simulated by a circular cylinder with elliptic end caps. If IFUSE=2, the cross-sectional areas of the fuselage are input, see sample cases 4 and 5. The wing/body input is performed only once during a grid sequencing run, usually a call to SOLVIN.

The input sequence for the wing/body data is:

1. Header card (1X)

2. XBOD,YBOD,ZBOD,RBOD,TL,ALF (8F10.6)

XBOD - Distance from nose of fuselage to leading edge of wing at the wing root

YBOD - Distance from centerline of the body to the wing root

ZBOD - Distance from centerline of the body to the centerline of the wing (positive is up)

RBOD - Radius of circular cylinder body for IFUSE = 1

TL - Length of the fuselage

ALF - Length of semimajor axis of ellipsoidal ends for IFUSE=1

if IFUSE = 2, input:

3. Header card (1X)

4. NST - Number of cross-sections to be input (I5)

5. XFL(I),AREA(I), I=1,NST (8F10.6)

XLF - % Fuselage length

AREA - Cross-sectional area at XFL

E. Inverse Design Input

When IINV=1 in SOLVIN, the target pressure distribution for the specified span stations must be input. If IDESN=1, the target pressures for both the upper and lower surfaces are input. If IDESN = 2 or 3, the target pressures for either the upper or the lower surface are input. The card sequence for the inverse design input is as follows; see sample data set 6:

1. Header card (1X)

2. JD1,JD2,NCPS (3I5)

JD1 - Index of initial spanwise inverse design station

JD2 - Index of final spanwise design station

NCPS - Number of chordwise points in the target pressure distribution

3. XUD(J,I), I=1,NCPS - Upper surface target Cp X/C locations (7F10.6)

4. CPDU(J,I), I=1,NCPS - Lower surface target Cp values (7F10.6)

5. XLD(J,I), I=1,NCPS - Lower surface target Cp X/C locations (7F10.6)

6. CPDL(J,I), I=1,NCPS - Lower surface target Cp values (7F10.6)

Repeat cards 3 through 6 for J=JD1,JD2

Omit cards 5 and 6 for IDESN=2

Omit cards 3 and 4 for IDESN=3

If relofting (IRLOFT .GT. 0) is selected for either viscous or inviscid design cases, the desired trailing edge ordinates of the surface being designed is input after the target pressure data. The card sequence for the relofting data is as follows:

1. Header card (1X)

2. NTE - Number of relofting stations input. This should be equal to the number of design stations (I5)

3. ZUTED(I) ,I=JD1,JD2 - Desired upper surface ordinate of design airfoil. (7F10.0)

4. ZLTED(I) ,I=JD1,JD2 - Desired lower surface ordinate of design

airfoil. (7F10.0)

Omit cards 4 for IDESN=2.

Omit cards 3 for IDESN=3.

DESCRIPTION OF OUTPUT

PRINTED OUTPUT

A typical output will have three sections. In the first section, the parameters that were input to define the wing geometry are echoed. The x location of the wing leading and trailing edges and slope of the leading edge and trailing edge lines at different span stations are printed along with the computed planform geometry parameters such as aspect ratio and taper ratio. These values are normalized by the root chord. The next section of data is generated during the solution process. At the end of each iteration, the iteration number, the grid indicies and values of the maximum correction and residual, the number of supersonic points, the current wing lift coefficient based on circulation and the average residual are printed. If IPRINT = 1 subroutine OUTPUT will be called to compute and print the section lift drag, and moment coefficients and the chordwise upper and lower surface pressure coefficient, density and mach number distributions at each spanwise grid station. A printer plot of the pressure coefficients is also generated.

During inverse runs the relofted shape is printed every NSHPF iterations. If relofting has been selected, the correction to the trailing edge thickness applied at each design station is printed.

When viscous analysis or design is selected, a summary of the boundary layer parameters are printed everyd NPRV updates of the boundary layer for both the upper and lower surfaces of the wing. In addition, a summary of the trailing edge displacement thickness at each wing station is printed every time the boundary layer is recalculated along with the computed skin

friction coefficient. The boundary layer summary includes printout of the local Reynolds number used in the boundary layer calculation, the local Mach number, the displacement thickness, the momentum thickness, and the separation index. A printer plot of wing sections before and after application of the displacement thickness is also printed every NPRV iterations.

MASS STORAGE OUTPUT

When the IPLOT flag is set, the program will output data to mass storage for plotting or other post-processing. The majority of data written to mass storage will be stored on logical unit 8. However, additional data will be stored on other units for design or viscous analysis runs. The definitions of these data are discussed in the following sections. The order and format of the data can be obtained from a listing of subroutine PLTOUT.

Data Stored on Logical Unit 8

TITLE1 - Test case title and description from input

TITLE2 - Test case title and description from input

MACH - Freestream mach number

AOA - Wing angle of attack

CLW - Computed wing lift coefficient

CDW - Computed wing drag coefficient

CMW - Computed wing pitching moment coefficient

CLG - Wing circulation lift coefficient

SREF - Wing reference area

CROOT - Wing root chord length

SPAN - Wing semi-span length

AR - Wing aspect ratio

JTPM1 - Number of chordwise computational grid planes on the wing

IDUM - Dummy integer

J - Index of chordwise grid plane along semi-span

ETA - Spanwise distance of grid plane J from the root normalized by the semi-span.

XLEW - X coordinate of wing leading edge on grid plane J

XTEW - X coordinate of wing trailing edge on grid plane J

CORDW - Local wing chord at grid plane J

NXB - Number of chordwise grid points on wing at grid plane J

JTIP - Index of the first grid plane off of the wing

YTIP - Eta location of the wing tip

XLET - X coordinate of the wing tip leading edge

XTET - X coordinate of the wing tip trailing edge

CTIP - Wing tip chord

XIN - X/C location of computed data

CPL - Lower surface pressure coefficient

CPU - Upper surface pressure coefficient

CLS - Sectional lift coefficient at grid plane J

CDS - Sectional drag coefficient at grid plane J

CMS - Sectional moment coefficient at grid plane J

TWIST - Twist angle of airfoil section at grid plane J

ZOCU - Wing section upper surface ordinates at computational grid X/C's. For viscous analysis and design these values will be for the fluid airfoil.

ZOCL - Wing section lower surface ordinates at computational grid X/C's. For viscous analysis and design these values will be for the fluid airfoil.

DZXU - Wing section upper surface slopes at computational grid X/C's. For viscous analysis and design these values will be for the fluid airfoil.

DZXL - Wing section lower surface slopes at computational grid X/C's. For viscous analysis and design these values will be for the fluid airfoil.

INU - Number of chordwise points used to define initial airfoil section upper surface.

INL - Number of chordwise points used to define initial airfoil section lower surface.

ZUPI - Airfoil section upper surface ordinates interpolated from the original input airfoil sections. ZUPI will change if relofting is used in design runs.

ZLPI - Airfoil section lower surface ordinates interpolated from original input airfoil sections. ZLPI will change if relofting is used in design runs.

ITCNT - Total number of iterations on all grids used in solution.

NSPT - The number of supersonic points at a given iteration.

CLGT - The circulation lift at a given iteration.

RMAXT - The maximum residual at a given iteration.

CMAXT - The maximum correction at a given iteration.

ZINU - X/C location of input airfoil upper surface ordinates.

XINL - X/C location of input airfoil lower surface ordinates.

XINUS - Initial values of XINU saved when IDESN .NE. 0.

XINLS - Initial values of XINL saved when IDESN .NE. 0.

ZUPS - Initial values of ZUPI saved when IDESN .NE. 0.

ZLPS - Initial values of ZLPI saved when IDESN .NE. 0.

Data Stored on Logical Unit 9 when ISVSHP .NE. 0.

TITLE1 - Test case title and description from input

NJD - Total number of inverse design stations

ETA - Spanwise distance of grid plane J from the root normalized by the semi-span.

NXB - Number of chordwise grid points on wing at grid plane J

XIN - X/C location of computed data

Data Stored on Logical Unit 20 when IVISC .NE. 0.

TITLE1 - Test case title and description from input

JTPM1 - Number of chordwise computational grid planes on the wing

NXB - Number of chordwise grid points on wing at grid plane J

XIN - X/C location of computed data

DPUOLD - Upper surface boundary layer displacement thickness

DPLOLD - Lower surface boundary layer displacement thickness

RESTART DATA

Data to restart either an analysis or design case from a previous run is stored on units 7 and 14 by subroutine SAVSOL. At the end of each case, the computational grid, reduced potential and circulation are stored in unformatted form on logical unit 7. For inverse design cases, the relofted ordinates resulting from the design are stored on logical unit 14 whenever ISRLOR .NE. 0.

APPENDIX A
SAMPLE DATA SETS

The following sample data sets were used in the evaluation of the direct/inverse design method.

SAMPLE DATA SET NO. 1
ONERA M6 VISCOUS INVERSE AT J=12

```
M6 VISCOUS INVERSE AT ONE STATION (J=12) USEING MODIFIED CP'S
MACH=0.8395 AOA=3.06
ONERA M6 ORDINATES- 50X30X30
         4         69         69          0
 0.000000  0.000323  0.000551  0.000866  0.001287  0.001836  0.002544  0.003443
 0.004570  0.005975  0.007711  0.009841  0.012448  0.015617  0.019461  0.024107
 0.029701  0.036426  0.044485  0.054125  0.065630  0.079337  0.095635  0.114980
 0.137896  0.164998  0.191933  0.218710  0.245331  0.271798  0.298111  0.324273
 0.350283  0.376145  0.401857  0.427422  0.452844  0.478120  0.503251  0.528243
 0.553094  0.577804  0.602376  0.626810  0.651109  0.675273  0.699303  0.723199
 0.746966  0.770600  0.794106  0.817483  0.840732  0.863856  0.886823  0.906191
 0.922534  0.936335  0.947995  0.957851  0.966186  0.973236  0.979202  0.984251
 0.988525  0.992144  0.995208  0.997803  1.000000
 0.000000  0.000323  0.000551  0.000866  0.001287  0.001836  0.002544  0.003443
 0.004570  0.005975  0.007711  0.009841  0.012448  0.015617  0.019461  0.024107
 0.029701  0.036426  0.044485  0.054125  0.065630  0.079337  0.095635  0.114980
 0.137896  0.164998  0.191933  0.218710  0.245331  0.271798  0.298111  0.324273
 0.350283  0.376145  0.401857  0.427422  0.452844  0.478120  0.503251  0.528243
 0.553094  0.577804  0.602376  0.626810  0.651109  0.675273  0.699303  0.723199
 0.746966  0.770600  0.794106  0.817483  0.840732  0.863856  0.886823  0.906191
 0.922534  0.936335  0.947995  0.957851  0.966186  0.973236  0.979202  0.984251
 0.988525  0.992144  0.995208  0.997803  1.000000
 0.000000  0.003138  0.004096  0.005134  0.006260  0.007478  0.008796  0.010216
 0.011742  0.013371  0.015095  0.016898  0.018754  0.020622  0.022455  0.024200
 0.025825  0.027332  0.028791  0.030328  0.032014  0.033837  0.035774  0.037792
 0.039852  0.041909  0.043621  0.045051  0.046236  0.047199  0.047949  0.048490
 0.048818  0.048930  0.048820  0.048483  0.047935  0.047166  0.046190  0.045021
 0.043674  0.042168  0.040524  0.038761  0.036899  0.034954  0.032940  0.030866
 0.028737  0.026550  0.024303  0.021984  0.019584  0.017091  0.014505  0.012239
 0.010273  0.008583  0.007142  0.005922  0.004891  0.004018  0.003280  0.002655
 0.002126  0.001678  0.001298  0.000977  0.000705
 0.000000 -0.003138 -0.004096 -0.005134 -0.006260 -0.007478 -0.008796 -0.010216
-0.011742 -0.013371 -0.015095 -0.016898 -0.018754 -0.020622 -0.022455 -0.024200
-0.025825 -0.027332 -0.028791 -0.030328 -0.032014 -0.033837 -0.035774 -0.037792
-0.039852 -0.041909 -0.043621 -0.045051 -0.046236 -0.047199 -0.047949 -0.048490
-0.048818 -0.048930 -0.048820 -0.048483 -0.047935 -0.047166 -0.046190 -0.045021
-0.043674 -0.042168 -0.040524 -0.038761 -0.036899 -0.034954 -0.032940 -0.030866
-0.028737 -0.026550 -0.024303 -0.021984 -0.019584 -0.017091 -0.014505 -0.012239
-0.010273 -0.008583 -0.007142 -0.005922 -0.004891 -0.004018 -0.003280 -0.002655
-0.002126 -0.001678 -0.001298 -0.000977 -0.000705
T    T
T    T
T    T
```

```
**** END OF SECTION DATA ****
              ONERA M6 PLANFORM DESCRIPTION
0.0       0.0       805.9     1196.3    690.68413 1143.5999
752960.07 646.07    201.475
          1
          2
0.0       0.0       1196.3    690.68413
.57735027 .57735027
          1
          2
0.0       805.9     1196.3    1143.5999
.28297148 .28297148
0.0       0.0       .20000    0.0       .60000    0.0       .99999    0.0
 COARSE SKEWED MESH
 &GPARM IPRNTG=0,WBCPRT=.F.,ISAMG=1,ISHEAR=0,NTIPLE=1&END
 &XGRID NXON=10,NXFWD=7,NXAFT=8,XFWD=-5.0,XAFT=8.0&END
 &YGRID NYON=20,NYOFF=10,YMAX=1.3&END
 &ZGRID NZ=8,ZP=3.655,&END
 &SOLVIN MACH=0.8395,AOA=3.06,MAXIT=200,OMEGX=1.92,
         OMEGY=1.92,OMEGZ=1.92,RCONV=.00001,
         CON=1.0,NGSEQ=3,BXI=0.0,IPRINT=0,ICIRPF=100,
         IPLOT=0,IPU=8,OMEGG=1.2,IKLUNK=1,IDESN=0&END
 MEDIUM SKEWED MESH
 &GPARM IPRNTG=0,WBCPRT=.F.,ISAMG=1,ISHEAR=0&END
 &XGRID NXON=25,NXFWD=10,NXAFT=10,XFWD=-5.0,XAFT=8.0&END
 &YGRID NYON=20,NYOFF=10,YMAX=1.3&END
 &ZGRID NZ=16,ZMAX=5.0&END
 &SOLVIN MAXIT=400,OMEGX=1.95,
         OMEGY=1.95,RCONV=.0001,IPRINT=0,ICIRPF=400,IVISC=1,NITRL=100,
         OMEGZ=1.95,CON=1.0,BXI=0.0,NDIF=0,IRLOFT=3,NITRF=10,
         IPLOT=0,IPU=8,OMEGG=1.2,IKLUNK=1,IDESN=2,ILED=16,
         ITED=35,NITDSN=50,ISVSHP=1,IINV=1&END
 &VISCDT ITR=10,NVISC=50,NPRV=401,NJPRV=9,RN=25000000.,DELCOR=.844&END
  ONERA M6 INVERSE WITH CP MODS
   12   12   50
   .010101   .030303   .050505   .070707   .090909   .111111   .131313
   .151515   .171717   .191919   .212121   .232323   .252525   .272727
   .292929   .313131   .333333   .353535   .373737   .393939   .414141
   .434343   .454545   .474747   .494949   .515152   .535354   .555556
   .575758   .595960   .616162   .636364   .656566   .676768   .696970
   .717172   .737374   .757576   .777778   .797980   .818182   .838384
   .858586   .878788   .898990   .919192   .939394   .959596   .979798
  1.000000
  -.346519 -1.127327 -1.172505 -1.109415  -.985884  -.830017  -.676677
  -.569370  -.524577  -.521298  -.535000  -.535000  -.535000  -.535000
  -.535000  -.535000  -.535000  -.535000  -.535000  -.535000  -.535000
  -.535000  -.535000  -.535000  -.525000  -.515000  -.465000  -.395000
  -.310000  -.210000  -.160000  -.149000  -.139435  -.126411  -.112294
  -.097759  -.083227  -.068499  -.053475  -.037875  -.020879  -.001868
```

```
  .020060    .045692    .075811    .111197    .152444    .200354    .260610
  .347980
 TRAILING EDGE THICKNESS TARGETS
   1
 0.01
 FINE SKEWED MESH
&GPARM IPRNTG=0,WBCPRT=.F.,ISAMG=1,ISHEAR=0&END
&XGRID NXON=50,NXFWD=20,NXAFT=20,XFWD=-5.0,XAFT=8.0&END
&YGRID NYON=20,NYOFF=10,YMAX=1.3&END
&ZGRID NZ=30,ZMAX=5.0&END
&SOLVIN MAXIT=400,OMEGX=1.85,OMEGY=1.85,OMEGZ=1.85,
        RCONV=.001,IPRINT=1,ICIRPF=400,NITRL=100,NITRF=10,
        IPLOT=1,IPU=8,OMEGG=1.2,IKLUNK=1,IPRSHP=0,ISRLOR=1,
        NJSHP=1,BXI=0.0,CON=1.0,ILED=31,ITED=70,NITDSN=1,IVISC=1&END
&VISCDT ITR=10,NVISC=50,NPRV=400,NJPRV=9,RN=25000000.,DELCOR=.844&END
```

SAMPLE DATA SET NO. 2
C5 INVISCID DESIGN AT J=1-19

```
C5 INVISCID INVERSE TEST CASE DESIGN STATIONS J=1-19
MACH=0.775 AOA=2.0
C5 ORDINATES
         5         31         31          0
  0.000000  0.002500  0.005000  0.007500  0.010000  0.020000  0.040000  0.060000
  0.080000  0.100000  0.120000  0.140000  0.160000  0.180000  0.200000  0.250000
  0.300000  0.350000  0.400000  0.450000  0.500000  0.550000  0.600000  0.650000
  0.700000  0.750000  0.800000  0.850000  0.900000  0.950000  1.000000
  0.000000  0.002500  0.005000  0.007500  0.010000  0.020000  0.040000  0.060000
  0.080000  0.100000  0.120000  0.140000  0.160000  0.180000  0.200000  0.250000
  0.300000  0.350000  0.400000  0.450000  0.500000  0.550000  0.600000  0.650000
  0.700000  0.750000  0.800000  0.850000  0.900000  0.950000  1.000000
  0.005629  0.011618  0.014906  0.017438  0.019562  0.025964  0.033540  0.039428
  0.043911  0.047641  0.050505  0.053343  0.055845  0.057955  0.060064  0.063924
  0.066743  0.068500  0.069185  0.069162  0.067669  0.065596  0.062679  0.059085
  0.054549  0.049070  0.042514  0.034879  0.025692  0.014690  0.001289
  0.005629 -0.004190 -0.007038 -0.008982 -0.010615 -0.015610 -0.023116 -0.029223
 -0.034191 -0.038352 -0.041568 -0.044785 -0.047620 -0.050058 -0.052488 -0.056812
 -0.059852 -0.061615 -0.062032 -0.061170 -0.059031 -0.055746 -0.051383 -0.045872
 -0.039654 -0.032971 -0.025789 -0.018461 -0.011621 -0.005749 -0.001289
T    F
  0.005809  0.011672  0.014924  0.017571  0.019632  0.026053  0.033823  0.039802
  0.044405  0.048000  0.051196  0.054105  0.056622  0.058782  0.060932  0.064926
  0.067822  0.069720  0.070620  0.070620  0.069721  0.067824  0.065028  0.061433
  0.056841  0.051152  0.044167  0.035851  0.025811  0.014433  0.001102
  0.005809 -0.003927 -0.007067 -0.009012 -0.010608 -0.015152 -0.021136 -0.025732
 -0.029260 -0.032049 -0.034070 -0.036030 -0.037737 -0.039097 -0.040457 -0.042838
 -0.044252 -0.044963 -0.044878 -0.044076 -0.042477 -0.040179 -0.037182 -0.033486
 -0.029001 -0.024299 -0.019404 -0.014604 -0.009811 -0.005317 -0.001102
T    F
  0.005803  0.011569  0.014967  0.017536  0.019638  0.026077  0.033879  0.039897
  0.044300  0.047900  0.051409  0.054366  0.056903  0.059081  0.061220  0.065323
  0.06824_  0.070083  0.071061  0.071169  0.070280  0.068432  0.065714  0.062026
  0.057580  0.051847  0.044714  0.035995  0.025915  0.013754  0.001094
  0.005803 -0.003995 -0.007043 -0.008954 -0.010571 -0.014972 -0.020606 -0.024799
 -0.027976 -0.030345 -0.032038 -0.033668 -0.035028 -0.036028 -0.037028 -0.038832
 -0.039827 -0.040179 -0.039969 -0.039203 -0.037795 -0.035693 -0.033193 -0.029862
 -0.026058 -0.021945 -0.017726 -0.013595 -0.009463 -0.005225 -0.001094
T    F
  0.006032  0.012488  0.015727  0.018285  0.020444  0.026978  0.034727  0.040687
  0.045100  0.048900  0.052100  0.055103  0.057433  0.059633  0.061791  0.065792
  0.068588  0.070417  0.071149  0.071025  0.069806  0.067614  0.064577  0.060598
  0.055848  0.050013  0.042853  0.034400  0.024790  0.013589  0.001108
  0.006032 -0.003871 -0.007209 -0.009141 -0.010737 -0.015212 -0.020623 -0.024567
```

```
 -0.027415 -0.029582 -0.031085 -0.032517 -0.033762 -0.034738 -0.035713 -0.037375
 -0.038636 -0.039376 -0.039394 -0.038790 -0.037429 -0.035359 -0.032617 -0.029446
 -0.025451 -0.021305 -0.017055 -0.012808 -0.008666 -0.004766 -0.001108
T    F
  0.000745  0.015880  0.019650  0.022717  0.024966  0.031731  0.039420  0.045103
  0.049100  0.052765  0.055845  0.058205  0.060562  0.062634  0.064687  0.068398
  0.071018  0.071863  0.071501  0.069947  0.067091  0.063104  0.058319  0.052545
  0.045971  0.038907  0.031906  0.024620  0.017412  0.009606  0.001006
  0.000745 -0.002368 -0.006812 -0.009262 -0.011326 -0.016277 -0.020702 -0.023207
 -0.024618 -0.025424 -0.025906 -0.026314 -0.026715 -0.027243 -0.027735 -0.029567
 -0.032057 -0.034703 -0.036336 -0.036447 -0.035379 -0.033157 -0.029948 -0.026146
 -0.021978 -0.017757 -0.012968 -0.008576 -0.004595 -0.002006 -0.001006
*** END OF C5 AIRFOIL DATA ***
C5 PLANFORM DESCRIPTION
0.0       0.0       79.21     178.80     94.36    123.36
18720.0   221.36    55.34
          2
          2
0.0       0.0       82.0      44.14
.538292683.538292683
          2
82.0      44.14     178.80    94.36
.518801653.518801653
          2
          2
0.0       79.21     82.0      93.21
.170731707.170731707
          2
82.0      93.21     178.80    123.36
.311466942.311466942
0.0       4.18      .388702461 2.9      .458612975 2.68     .604026846 2.18
1.0       -0.9
26X30X8 MESH
 &GPARM IPRNTG=0,WBCPRT=.F.,ISAMG=1,ISHEAR=0,NTIPLE=1&END
 &XGRID NXON=10,NXFWD=8,NXAFT=8,XFWD=-5.0,XAFT=8.0&END
 &YGRID NYON=20,NYOFF=10,YMAX=1.5&END
 &ZGRID NZ=8,ZP=3.3&END
 &SOLVIN MACH=.775,AOA=2.00,MAXIT=220,OMEGX=1.92,
         OMEGY=1.92,RCONV=.00001,IPRINT=0,ICIRPF=220,
         OMEGZ=1.92,CON=1.0,NGSEQ=3,BXI=0.0,
         IPLOT=0,IPU=8,OMEGG=1.2,IKLUNK=0,IDESN=0&END
 45X30X16 MESH
 &GPARM IPRNTG=0,WBCPRT=.F.,ISAMG=1,ISHEAR=0,NTIPLE=1&END
 &XGRID NXON=25,NXFWD=10,NXAFT=10,XFWD=-5.0,XAFT=8.0&END
 &YGRID NYON=20,NYOFF=10,YMAX=1.5&END
 &ZGRID NZ=16,ZP=1.75,ZMAX=5.0&END
 &SOLVIN MAXIT=300,OMEGX=1.92,
         OMEGY=1.92,RCONV=.0001,IPRINT=0,ICIRPF=300,NITRL=100,NJSHP=4,
         OMEGZ=1.92,CON=1.0,IPRSHP=0,IRLOFT=3,
```

```
        IPLOT=0,IPU=8,OMEGG=1.2,IKLUNK=0,IDESN=2,ILED=16,NITRF=10,
        ITED=35,NITDSN=50,ISVSHP=1,IINV=1,IVISC=0&END
C5 INV MOD 4 LINEAR CP RECOVERY J=1-19
   1   19   50
 0.010101  0.030303  0.050505  0.070707  0.090909  0.111111  0.131313
 0.151515  0.171717  0.191919  0.212121  0.232323  0.252525  0.272727
 0.292929  0.313131  0.333333  0.353535  0.373737  0.393939  0.414141
 0.434343  0.454545  0.474747  0.494949  0.515152  0.535354  0.555556
 0.575758  0.595960  0.616162  0.636364  0.656566  0.676768  0.696970
 0.717172  0.737374  0.757576  0.777778  0.797980  0.818182  0.838384
 0.858586  0.878788  0.898990  0.919192  0.939394  0.959596  0.979798
 1.000000
 0.250413 -0.547996 -0.690000 -0.750000 -0.770000 -0.790000 -0.800000
-0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000
-0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000
-0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000
-0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.790000
-0.780000 -0.760000 -0.720000 -0.680000 -0.620000 -0.560000 -0.480000
-0.440000 -0.350000 -0.260000 -0.160000 -0.040000  0.065930  0.179936
 0.345951
 0.010101  0.030303  0.050505  0.070707  0.090909  0.111111  0.131313
 0.151515  0.171717  0.191919  0.212121  0.232323  0.252525  0.272727
 0.292929  0.313131  0.333333  0.353535  0.373737  0.393939  0.414141
 0.434343  0.454545  0.474747  0.494949  0.515152  0.535354  0.555556
 0.575758  0.595960  0.616162  0.636364  0.656566  0.676768  0.696970
 0.717172  0.737374  0.757576  0.777778  0.797980  0.818182  0.838384
 0.858586  0.878788  0.898990  0.919192  0.939394  0.959596  0.979798
 1.000000
-0.133011 -0.834330 -0.865831 -0.850000 -0.830000 -0.800000 -0.800000
-0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000
-0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000
-0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000
-0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.790000 -0.770000
-0.740000 -0.700000 -0.670000 -0.610000 -0.550000 -0.500000 -0.420000
-0.350000 -0.250000 -0.160000 -0.090000  0.020967  0.103324  0.210316
 0.358176
 0.010101  0.030303  0.050505  0.070707  0.090909  0.111111  0.131313
 0.151515  0.171717  0.191919  0.212121  0.232323  0.252525  0.272727
 0.292929  0.313131  0.333333  0.353535  0.373737  0.393939  0.414141
 0.434343  0.454545  0.474747  0.494949  0.515152  0.535354  0.555556
 0.575758  0.595960  0.616162  0.636364  0.656566  0.676768  0.696970
 0.717172  0.737374  0.757576  0.777778  0.797980  0.818182  0.838384
 0.858586  0.878788  0.898990  0.919192  0.939394  0.959596  0.979798
 1.000000
-0.301318 -0.944470 -1.040394 -0.930000 -0.850000 -0.820000 -0.800000
-0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000
-0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000
-0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000 -0.800000
-0.800000 -0.800000 -0.800000 -0.790000 -0.770000 -0.750000 -0.720000
```

-0.680000 -0.640000 -0.590000 -0.540000 -0.470000 -0.400000 -0.350000
-0.280000 -0.200000 -0.130000 -0.060000 0.032365 0.113458 0.217601
0.361156
0.010101 0.030303 0.050505 0.070707 0.090909 0.111111 0.131313
0.151515 0.171717 0.191919 0.212121 0.232323 0.252525 0.272727
0.292929 0.313131 0.333333 0.353535 0.373737 0.393939 0.414141
0.434343 0.454545 0.474747 0.494949 0.515152 0.535354 0.555556
0.575758 0.595960 0.616162 0.636364 0.656566 0.676768 0.696970
0.717172 0.737374 0.757576 0.777778 0.797980 0.818182 0.838384
0.858586 0.878788 0.898990 0.919192 0.939394 0.959596 0.979798
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-0.789175 -1.184176 -1.268442 -1.315068 -1.351130 -1.346501 -1.335827
-1.312219 -1.276365 -1.245651 -1.220000 -1.210000 -1.200000 -1.200000
-1.200000 -1.200000 -1.200000 -1.200000 -1.200000 -1.200000 -1.200000
-1.200000 -1.200000 -1.200000 -1.200000 -1.200000 -1.170000 -1.110000
-1.040000 -0.974283 -0.908566 -0.842848 -0.777131 -0.711414 -0.645697
-0.579979 -0.514262 -0.448545 -0.382828 -0.317111 -0.251394 -0.185677
-0.119959 -0.054242  0.011475  0.077192  0.142909  0.208627  0.274344
 0.340061
  TRAILING EDGE THICKNESS TARGETS
  19
 0.002     0.002     0.002     0.002     0.002     0.002     0.002
 0.002     0.002     0.002     0.002     0.002     0.002     0.002
 0.002     0.002     0.002     0.002     0.002
90X30X30 GRID
&GPARM IPRNTG=0,WBCPRT=.F.,ISAMG=1,ISHEAR=0&END
&XGRID NXON=50,NXFWD=20,NXAFT=20&END
&YGRID NYON=20,NYOFF=10,YMAX=1.5&END
&ZGRID NZ=30&END
&SOLVIN MAXIT=300,OMEGX=1.90,NITRL=20,NITRF=40,
        OMEGY=1.90,RCONV=.001,IPRINT=1,ICIRPF=300,ISVSHP=1,
        OMEGZ=1.90,IPLOT=1,IPU=8,OMEGG=1.2,IKLUNK=0,ISRLOR=1,
        BXI=0.0,CON=1.0,ILED=31,ITED=70,NITDSN=1,IPRSHP=0&END
```

SAMPLE DATA SET NO. 3
RAE WING BODY TEST CASE

```
RAE WING A WING BODY TEST CASE
MACH=0.80 AOA=2.0
RAE WING "A" ORDINATES
         2         86         86          0
 0.000000  0.001000  0.002000  0.003000  0.004000  0.005000  0.006000  0.007000
 0.007500  0.008000  0.009000  0.010000  0.012000  0.012500  0.014000  0.016000
 0.018000  0.020000  0.025000  0.030000  0.035000  0.040000  0.050000  0.060000
 0.070000  0.075000  0.080000  0.090000  0.100000  0.120000  0.140000  0.150000
 0.160000  0.180000  0.200000  0.220000  0.240000  0.250000  0.260000  0.280000
 0.300000  0.320000  0.340000  0.350000  0.360000  0.380000  0.400000  0.420000
 0.440000  0.450000  0.460000  0.480000  0.500000  0.520000  0.540000  0.550000
 0.560000  0.580000  0.600000  0.620000  0.640000  0.650000  0.660000  0.680000
 0.700000  0.720000  0.740000  0.750000  0.760000  0.780000  0.800000  0.820000
 0.840000  0.850000  0.860000  0.880000  0.900000  0.920000  0.925000  0.940000
 0.950000  0.960000  0.975000  0.980000  0.987500  1.000000
 0.000000  0.001000  0.002000  0.003000  0.004000  0.005000  0.006000  0.007000
 0.007500  0.008000  0.009000  0.010000  0.012000  0.012500  0.014000  0.016000
 0.018000  0.020000  0.025000  0.030000  0.035000  0.040000  0.050000  0.060000
 0.070000  0.075000  0.080000  0.090000  0.100000  0.120000  0.140000  0.150000
 0.160000  0.180000  0.200000  0.220000  0.240000  0.250000  0.260000  0.280000
 0.300000  0.320000  0.340000  0.350000  0.360000  0.380000  0.400000  0.420000
 0.440000  0.450000  0.460000  0.480000  0.500000  0.520000  0.540000  0.550000
 0.560000  0.580000  0.600000  0.620000  0.640000  0.650000  0.660000  0.680000
 0.700000  0.720000  0.740000  0.750000  0.760000  0.780000  0.800000  0.820000
 0.840000  0.850000  0.860000  0.880000  0.900000  0.920000  0.925000  0.940000
 0.950000  0.960000  0.975000  0.980000  0.987500  1.000000
 0.000000  0.003515  0.004966  0.006078  0.007013  0.007835  0.008576  0.009256
 0.009578  0.009888  0.010480  0.011039  0.012074  0.012318  0.013022  0.013901
 0.014721  0.015494  0.017257  0.018832  0.020262  0.021577  0.023903  0.026008
 0.027863  0.028722  0.029540  0.031067  0.032466  0.034938  0.037046  0.037982
 0.038847  0.040380  0.041674  0.042746  0.043610  0.043966  0.044271  0.044730
 0.044972  0.044960  0.044752  0.044582  0.044376  0.043855  0.043205  0.042438
 0.041565  0.041091  0.040595  0.039539  0.038403  0.037196  0.035924  0.035265
 0.034592  0.033209  0.031779  0.030308  0.028803  0.028039  0.027267  0.025707
 0.024126  0.022531  0.020926  0.020121  0.019317  0.017707  0.016097  0.014487
 0.012878  0.012073  0.011268  0.009658  0.008049  0.006439  0.006036  0.004829
 0.004024  0.003219  0.002012  0.001610  0.001006  0.000000
 0.000000 -0.003515 -0.004966 -0.006078 -0.007013 -0.007835 -0.008576 -0.009256
-0.009578 -0.009888 -0.010480 -0.011039 -0.012074 -0.012318 -0.013022 -0.013901
-0.014721 -0.015494 -0.017257 -0.018832 -0.020262 -0.021577 -0.023903 -0.026008
-0.027863 -0.028722 -0.029540 -0.031067 -0.032466 -0.034938 -0.037046 -0.037982
-0.038847 -0.040380 -0.041674 -0.042746 -0.043610 -0.043966 -0.044271 -0.044730
-0.044972 -0.044960 -0.044752 -0.044582 -0.044376 -0.043855 -0.043205 -0.042438
```

```
 -0.041565 -0.041091 -0.040595 -0.039539 -0.038403 -0.037196 -0.035924 -0.035265
 -0.034592 -0.033209 -0.031779 -0.030308 -0.028803 -0.028039 -0.027267 -0.025707
 -0.024126 -0.022531 -0.020926 -0.020121 -0.019317 -0.017707 -0.016097 -0.014487
 -0.012878 -0.012073 -0.011268 -0.009658 -0.008049 -0.006439 -0.006036 -0.004829
 -0.004024 -0.003219 -0.002012 -0.001610 -0.001006  0.000000
T    T
*** END OF RAE AIRFOIL DATA ***
RAE WING PLANFORM DESCRIPTION
0.0        0.0        8.0        15.0       11.160306 14.160306
82.5       5.5        7.208
           1
           2
0.0        0.0        15.0       11.160306
.744020    .744020
           1
           2
0.0        8.0        15.0       14.160306
.410946    .410946
0.0        0.0        1.0        0.0
 26X30X8
 &GPARM IPRNTG=0,WBCPRT=.F.,ISAMG=1,ISHEAR=0,NTIPLE=1&END
 &XGRID NXON=10,NXFWD=8,NXAFT=8,XFWD=-5.XAFT=8.0&END
 &YGRID NYON=20,NYOFF=10,YMAX=1.4&END
 &ZGRID NZ=8,ZP=3.3&END
 &SOLVIN MACH=0.80,AOA=2.0,MAXIT=400,OMEGX=1.92,
         OMEGY=1.92,RCONV=.00001,IPRINT=0,ICIRPF=100,
         OMEGZ=1.92,CON=1.0,NGSEQ=3,BXI=0.0,NF=30,
         IPLOT=0,IPU=8.OMEGG=1.2,IKLUNK=1,IFUSE=2&END
  XBODY      YBODY      ZBODY      RBODY      LENGTH     ALF
  22.232     3.         0.         3.0        70.        16.
  NST
   20
   XF        AREA
   0.0     0.0
   2.0     2.58155
   4.0     8.33570
   6.0     14.87571
   8.0     20.62897
  10.0     24.78582
  12.0     27.18065
  14.0     28.13185
  16.0     28.27433
  22.0     28.27433
  28.0     28.27433
  32.0     28.27433
  36.0     28.27433
  40.0     28.27433
  45.95    28.27433
  47.0     21.64754
```

```
 48.0     15.90431
 49.0     11.04466
 50.0     7.06858
 70.      3.14159
45X30X16 GRID
&GPARM IPRNTG=0,WBCPRT=.F.&END
&XGRID NXON=25,NXFWD=10,NXAFT=10&END
&YGRID NYON=20,NYOFF=10,YMAX=1.4,RTSWCH=1.0&END
&ZGRID NZ=16,ZMAX=5.0&END
&SOLVIN MAXIT=400,OMEGX=1.9,
        OMEGY=1.9,RCONV=.0001,ICIRPF=100,
        OMEGZ=1.9&END
90X30X30 GRID
&GPARM IPRNTG=0&END
&XGRID NXON=50,NXFWD=20,NXAFT=20&END
&YGRID NYON=20,NYOFF=10,YMAX=1.4&END
&ZGRID NZ=30&END
&SOLVIN MAXIT=100,OMEGX=1.9,
        OMEGY=1.9,RCONV=.001,IPRINT=1,ICIRPF=50,
        OMEGZ=1.9,IPLOT=1,IPU=8,OMEGG=1.2,IKLUNK=1&END
```

SAMPLE DATA SET NO. 4
F14 INVISCID ANALYSIS

```
F14 INVISCID ANALYSIS WITH BOPPE CODE ORDINATES 2 GRIDS
MACH = .8 AOA=1.4
F14 ORDINATES-FROM GRUMMAN REPORT
        9        50        50         0
 0.000000  0.001910  0.004960  0.009950  0.020000  0.039930  0.060000  0.080000
 0.100000  0.120000  0.140000  0.160000  0.180000  0.200000  0.220000  0.240000
 0.260000  0.280000  0.300000  0.320000  0.340000  0.360000  0.380000  0.400000
 0.420000  0.440000  0.460000  0.480000  0.500000  0.520000  0.560000  0.600000
 0.640000  0.680000  0.700000  0.720000  0.740000  0.760000  0.780000  0.800000
 0.820000  0.840000  0.860000  0.880000  0.900000  0.920000  0.940000  0.960000
 0.980000  1.000000
 0.000000  0.001910  0.004960  0.009950  0.020000  0.039930  0.060000  0.080000
 0.100000  0.120000  0.140000  0.160000  0.180000  0.200000  0.220000  0.240000
 0.260000  0.280000  0.300000  0.320000  0.340000  0.360000  0.380000  0.400000
 0.420000  0.440000  0.460000  0.480000  0.500000  0.520000  0.560000  0.600000
 0.640000  0.680000  0.700000  0.720000  0.740000  0.760000  0.780000  0.800000
 0.820000  0.840000  0.860000  0.880000  0.900000  0.920000  0.940000  0.960000
 0.980000  1.000000
 0.004660  0.010460  0.014220  0.018540  0.025040  0.034540  0.041700  0.047300
 0.051770  0.055340  0.058180  0.060420  0.062140  0.063440  0.064370  0.064990
 0.065330  0.065430  0.065320  0.065020  0.064560  0.063950  0.063200  0.062320
 0.061330  0.060230  0.059030  0.057730  0.056350  0.054870  0.051650  0.048100
 0.044240  0.040070  0.037880  0.035610  0.033280  0.030880  0.028420  0.025900
 0.023320  0.020690  0.018000  0.015280  0.012510  0.009710  0.006880  0.004030
 0.001170 -0.001710
 0.004660 -0.001580 -0.005400 -0.009910 -0.015700 -0.022670 -0.027140 -0.030320
-0.032720 -0.034590 -0.036060 -0.037210 -0.038100 -0.038760 -0.039210 -0.039490
-0.039600 -0.039570 -0.039400 -0.039120 -0.038730 -0.038240 -0.037660 -0.037010
-0.036290 -0.035510 -0.034680 -0.033810 -0.032900 -0.031960 -0.030000 -0.027960
-0.025870 -0.023770 -0.022720 -0.021660 -0.020620 -0.019570 -0.018540 -0.017510
-0.016490 -0.015470 -0.014470 -0.013470 -0.012480 -0.011500 -0.010520 -0.009550
-0.008580 -0.007610
T    F
 0.007560  0.013570  0.017100  0.021010  0.026720  0.034850  0.040950  0.045820
 0.049830  0.053170  0.055960  0.058270  0.060170  0.061700  0.062910  0.063810
 0.064440  0.064820  0.064960  0.064890  0.064620  0.064160  0.063520  0.062710
 0.061750  0.060640  0.059380  0.058000  0.056480  0.054850  0.051240  0.047220
 0.042840  0.038120  0.035660  0.033130  0.030540  0.027900  0.025210  0.022470
 0.019700  0.016890  0.014050  0.011190  0.008300  0.005400  0.002490 -0.000430
-0.003350 -0.006280
 0.007560  0.001820 -0.001760 -0.005480 -0.010130 -0.015670 -0.019220 -0.021780
-0.023750 -0.025320 -0.026610 -0.027680 -0.028570 -0.029320 -0.029940 -0.030460
-0.030870 -0.031200 -0.031440 -0.031600 -0.031680 -0.031690 -0.031630 -0.031500
```

```
 -0.031300 -0.031050 -0.030730 -0.030360 -0.029930 -0.029450 -0.028340 -0.027060
 -0.025620 -0.024050 -0.023220 -0.022360 -0.021480 -0.020580 -0.019660 -0.018720
 -0.017770 -0.016800 -0.015820 -0.014840 -0.013850 -0.012850 -0.011850 -0.010850
 -0.009840 -0.008840
T    F
  0.008780  0.014880  0.018310  0.022050  0.027420  0.034980  0.040630  0.045190
  0.049010  0.052260  0.055020  0.057370  0.059340  0.060970  0.062290  0.063310
  0.064060  0.064560  0.064810  0.064830  0.064640  0.064240  0.063650  0.062880
  0.061930  0.060810  0.059530  0.058110  0.056540  0.054840  0.051070  0.046850
  0.042240  0.037300  0.034730  0.032090  0.029390  0.026650  0.023860  0.021030
  0.018180  0.015290  0.012390  0.009470  0.006530  0.003590  0.000640 -0.002310
 -0.005260 -0.008210
  0.008780  0.003240 -0.000230 -0.003620 -0.007780 -0.012730 -0.015890 -0.018190
 -0.019970 -0.021420 -0.022630 -0.023660 -0.024550 -0.025340 -0.026040 -0.026650
 -0.027200 -0.027670 -0.028080 -0.028430 -0.028710 -0.028930 -0.029090 -0.029180
 -0.029200 -0.029170 -0.029070 -0.028900 -0.028680 -0.028390 -0.027650 -0.026680
 -0.025520 -0.024170 -0.023430 -0.022660 -0.021850 -0.021000 -0.020130 -0.019230
 -0.018310 -0.017360 -0.016390 -0.015410 -0.014420 -0.013420 -0.012410 -0.011390
 -0.010370 -0.009350
T    F
  0.007220  0.013270  0.016570  0.020330  0.025640  0.033000  0.038520  0.043010
  0.046820  0.050100  0.052940  0.055400  0.057510  0.059300  0.060780  0.061980
  0.062910  0.063590  0.064020  0.064210  0.064190  0.063950  0.063510  0.062870
  0.062050  0.061050  0.059890  0.058560  0.057080  0.055460  0.051820  0.047700
  0.043170  0.038280  0.035720  0.033100  0.030420  0.027700  0.024920  0.022110
  0.019270  0.016400  0.013510  0.010610  0.007700  0.004780  0.001850 -0.001070
 -0.004000 -0.006920
  0.007220  0.001650 -0.001730 -0.005030 -0.008970 -0.013570 -0.016500 -0.018630
 -0.020290 -0.021640 -0.022770 -0.023750 -0.024610 -0.025370 -0.026060 -0.026680
 -0.027230 -0.027720 -0.028160 -0.028530 -0.028840 -0.029090 -0.029280 -0.029400
 -0.029450 -0.029440 -0.029360 -0.029210 -0.029000 -0.028710 -0.027950 -0.026940
 -0.025700 -0.024240 -0.023430 -0.022580 -0.021680 -0.020740 -0.019770 -0.018760
 -0.017720 -0.016650 -0.015560 -0.014450 -0.013320 -0.012170 -0.011020 -0.009860
 -0.008690 -0.007530
T    F
  0.003160  0.009280  0.012600  0.016420  0.021800  0.029280  0.034900  0.039490
  0.043410  0.046820  0.049810  0.052430  0.054720  0.056710  0.058400  0.059820
  0.060980  0.061890  0.062560  0.063010  0.063230  0.063240  0.063040  0.062650
  0.062070  0.061310  0.060380  0.059280  0.058020  0.056620  0.053380  0.049640
  0.045450  0.040870  0.038460  0.035980  0.033420  0.030810  0.028150  0.025440
  0.022700  0.019920  0.017120  0.014300  0.011460  0.008610  0.005750  0.002900
  0.000040 -0.002820
  0.003160 -0.002590 -0.005810 -0.009040 -0.012920 -0.017390 -0.020190 -0.022200
 -0.023750 -0.025010 -0.026060 -0.026960 -0.027750 -0.028440 -0.029060 -0.029620
 -0.030100 -0.030520 -0.030880 -0.031170 -0.031390 -0.031550 -0.031630 -0.031640
 -0.031580 -0.031440 -0.031230 -0.030940 -0.030570 -0.030140 -0.029050 -0.027680
 -0.026050 -0.024180 -0.023160 -0.022090 -0.020970 -0.019800 -0.018590 -0.017340
 -0.016060 -0.014740 -0.013400 -0.012030 -0.010640 -0.009230 -0.007810 -0.006380
 -0.004940 -0.003500
```

```
T     F
 -0.002100  0.004120  0.007540  0.011340  0.016800  0.024410  0.030160  0.034880
  0.038930  0.042490  0.045650  0.048450  0.050940  0.053140  0.055070  0.056750
  0.058170  0.059360  0.060320  0.061060  0.061580  0.061890  0.062000  0.061910
  0.061640  0.061180  0.060540  0.059740  0.058770  0.057650  0.054960  0.051730
  0.048020  0.043880  0.041680  0.039390  0.037020  0.034580  0.032090  0.029540
  0.026940  0.024310  0.021640  0.018940  0.016230  0.013490  0.010750  0.008000
  0.005250  0.002490
 -0.002100 -0.007870 -0.011230 -0.014270 -0.017990 -0.022260 -0.024900 -0.026740
 -0.028140 -0.029260 -0.030190 -0.030980 -0.031670 -0.032270 -0.032800 -0.033250
 -0.033630 -0.033950 -0.034190 -0.034360 -0.034460 -0.034470 -0.034410 -0.034260
 -0.034040 -0.033730 -0.033340 -0.032860 -0.032300 -0.031670 -0.030150 -0.028330
 -0.026220 -0.023840 -0.022560 -0.021220 -0.019820 -0.018370 -0.016870 -0.015320
 -0.013740 -0.012110 -0.010460 -0.008770 -0.007060 -0.005330 -0.003580 -0.001830
 -0.000060  0.001710
T     F
 -0.009190 -0.003000  0.000610  0.004520  0.010080  0.017870  0.023780  0.028650
  0.032870  0.036590  0.039930  0.042940  0.045660  0.048100  0.050300  0.052260
  0.053990  0.055500  0.056790  0.057880  0.058760  0.059440  0.059920  0.060220
  0.060330  0.060260  0.060010  0.059600  0.059020  0.058280  0.056340  0.053840
  0.050830  0.047350  0.045450  0.043470  0.041390  0.039230  0.037000  0.034710
  0.032350  0.029940  0.027490  0.025000  0.022490  0.019940  0.017380  0.014810
  0.012230  0.009650
 -0.009190 -0.014990 -0.018310 -0.021310 -0.024870 -0.028830 -0.031180 -0.032780
 -0.033960 -0.034880 -0.035630 -0.036260 -0.036790 -0.037220 -0.037580 -0.037860
 -0.038060 -0.038180 -0.038220 -0.038180 -0.038050 -0.037840 -0.037530 -0.037150
 -0.036670 -0.036100 -0.035450 -0.034700 -0.033870 -0.032960 -0.030870 -0.028460
 -0.025730 -0.022720 -0.021110 -0.019430 -0.017690 -0.015900 -0.014040 -0.012140
 -0.010190 -0.008200 -0.006170 -0.004100 -0.002010  0.000110  0.002250  0.004400
  0.006560  0.008730
T     F
 -0.019120 -0.012950 -0.009370 -0.005400  0.000370  0.008440  0.014560  0.019630
  0.024040  0.027960  0.031510  0.034740  0.037710  0.040430  0.042930  0.045210
  0.047290  0.049170  0.050850  0.052350  0.053660  0.054790  0.055740  0.056520
  0.057120  0.057550  0.057810  0.057910  0.057850  0.057640  0.056760  0.055310
  0.053330  0.050870  0.049470  0.047960  0.046350  0.044660  0.042870  0.041010
  0.039080  0.037080  0.035030  0.032920  0.030780  0.028600  0.026390  0.024160
  0.021920  0.019680
 -0.019120 -0.025250 -0.028510 -0.031390 -0.034700 -0.038160 -0.040020 -0.041170
 -0.041950 -0.042510 -0.042930 -0.043220 -0.043420 -0.043530 -0.043540 -0.043470
 -0.043320 -0.043080 -0.042750 -0.042340 -0.041840 -0.041250 -0.040580 -0.039820
 -0.038970 -0.038030 -0.037000 -0.035880 -0.034680 -0.033380 -0.030540 -0.027350
 -0.023850 -0.020030 -0.018010 -0.015920 -0.013760 -0.011540 -0.009260 -0.006920
 -0.004520 -0.002080  0.000400  0.002920  0.005480  0.008060  0.010670  0.013290
  0.015920  0.018560
T     F
 -0.034510 -0.028160 -0.024430 -0.020280 -0.014350 -0.005910  0.000530  0.005870
  0.010530  0.014700  0.018500  0.022000  0.025250  0.028270  0.031090  0.033730
  0.036180  0.038470  0.040600  0.042560  0.044370  0.046020  0.047520  0.048870
```

```
 0.050070  0.051120  0.052020  0.052780  0.053400  0.053880  0.054440  0.054490
 0.054050  0.053170  0.052570  0.051870  0.051070  0.050190  0.049230  0.048200
 0.047090  0.045920  0.044700  0.043430  0.042120  0.040780  0.039410  0.038020
 0.036620  0.035210
-0.034510 -0.040970 -0.044000 -0.046630 -0.049350 -0.051350 -0.051670 -0.051490
-0.051150 -0.050760 -0.050360 -0.049950 -0.049510 -0.049030 -0.048510 -0.047930
-0.047290 -0.046580 -0.045800 -0.044950 -0.044010 -0.042990 -0.041870 -0.040670
-0.039380 -0.037990 -0.036500 -0.034920 -0.033240 -0.031470 -0.027630 -0.023410
-0.018840 -0.013920 -0.011350 -0.008690 -0.005970 -0.003170 -0.000310  0.002610
 0.005580  0.008590  0.011660  0.014750  0.017880  0.021040  0.024210  0.027400
 0.030600  0.033800
 ***      END OF AIRFOIL DATA ***
     F14 PLANFORM DESCRIPTION
0.0        0.0        167.20971 384.69995 140.06494 184.32837
40676.853 160.0      76.00073
          1
          2
0.0        0.0        384.69995 140.06494
.364088792.364088792
          1
          2
0.0        167.20971 384.69995 184.32837
.047914841.047914841
0.0        0.0        .330725    0.0       .42634     0.0       .52196     0.0
.61758     0.0        .71320     0.0       .80882     0.0       .90444     0.0
1.0         0.0
 45X30X16 MESH
 &GPARM IPRNTG=0,WBCPRT=.F.,ISAMG=1,ISHEAR=0,NTIPLE=1&END
 &XGRID NXON=25,NXFWD=10,NXAFT=10,XFWD=-5.0,XAFT=8.0&END
 &YGRID NYON=20,NYOFF=10,YMAX=2.0&END
 &ZGRID NZ=16,ZP=1.75,ZMAX=5.0&END
 &SOLVIN MACH=.80,AOA=1.4,NGSEQ=2,MAXIT=300,RCONV=.001,
         OMEGX=1.80,OMEGY=1.80,OMEGZ=1.80,OMEGG=1.2,
         IPRINT=0,IPLOT=0,ICIRPF=100,IKLUNK=1,
         CON=1.0,BXI=0.0&END
 90X30X30 MESH
 &GPARM IPRNTG=0&END
 &XGRID NXON=50.NXFWD=20,NXAFT=20&END
 &YGRID NYON=20,NYOFF=10&END
 &ZGRID NZ=30&END
 &SOLVIN MAXIT=300,RCONV=.001,IPRINT=1,IPLOT=1,ICIRPF=300,
         OMEGX=1.8,OMEGY=1.8,OMEGZ=1.8,OMEGG=1.2&END
```

SAMPLE DATA SET NO. 5
WING A VISCOUS ANALYSIS

```
 WING A VISCOUS ANALYSIS
 MACH=0.80 AOA=1.2
 WINGA ORDINATES
         2         33         33          0
  0.000000  0.002408  0.009607  0.021530  0.038060  0.059039  0.084265  0.113495
  0.146447  0.182803  0.222215  0.264302  0.308658  0.354858  0.402455  0.450991
  0.500000  0.549009  0.597545  0.645142  0.691342  0.735698  0.777785  0.817197
  0.853553  0.886505  0.915735  0.940961  0.961940  0.978470  0.990393  0.997592
  1.000000
  0.000000  0.002408  0.009607  0.021530  0.038060  0.059039  0.084265  0.113495
  0.146447  0.182803  0.222215  0.264302  0.308658  0.354858  0.402455  0.450991
  0.500000  0.549009  0.597545  0.645142  0.691342  0.735698  0.777785  0.817197
  0.853553  0.886505  0.915735  0.940961  0.961940  0.978470  0.990393  0.997592
  1.000000
  0.000000  0.009523  0.017576  0.024310  0.030180  0.034958  0.038571  0.041361
  0.043645  0.045539  0.047036  0.048065  0.048637  0.048737  0.048351  0.047358
  0.045740  0.043449  0.040624  0.037256  0.033534  0.029576  0.025544  0.021533
  0.017667  0.014102  0.010867  0.008059  0.005745  0.003816  0.002366  0.001245
  0.000801
  0.000000 -0.007998 -0.015781 -0.022051 -0.028216 -0.034320 -0.040552 -0.046841
 -0.053095 -0.058886 -0.063909 -0.067723 -0.070312 -0.071256 -0.070937 -0.068816
 -0.065403 -0.060078 -0.053487 -0.045480 -0.036948 -0.028384 -0.020344 -0.013234
 -0.007335 -0.002835  0.000160  0.001680  0.001953  0.001417  0.000485 -0.000425
 -0.000803
T    F
  0.000000  0.007883  0.016974  0.025572  0.033052  0.039841  0.046100  0.051716
  0.056576  0.060668  0.064013  0.066654  0.068589  0.069825  0.070362  0.070214
  0.069431  0.067991  0.065908  0.063109  0.059558  0.055045  0.049478  0.042953
  0.035847  0.028744  0.022061  0.016177  0.011340  0.007448  0.004805  0.002848
  0.002073
  0.000000 -0.008988 -0.015880 -0.021410 -0.025889 -0.029641 -0.033196 -0.036588
 -0.039898 -0.042959 -0.045616 -0.047750 -0.049215 -0.049918 -0.049642 -0.048016
 -0.044596 -0.039227 -0.032380 -0.024781 -0.017099 -0.009966 -0.003808  0.000991
  0.004231  0.005957  0.006171  0.005222  0.003575  0.001547 -0.000032 -0.001456
 -0.002070
*** END OF WINGA AIRFOIL DATA ***
WINGA PLANFORM DESCRIPTION
0.0       0.0          6.500     18.00000 9.36853     11.96853
81.8      4.825      5.221
          1
          2
0.0       0.0        18.000       9.36853
.520474    .520474
```

```
          1
          2
0.0        6.5        18.000      11.96853
.303808    .303808
0.0        2.57       1.0         -2.00
 25X30X8 GRID
 &GPARM IPRNTG=0,WBCPRT=.F.,ISAMG=1,NTIPLE=1&END
 &XGRID NXON=10,NXFWD=7,NXAFT=8,XFWD=-5.0,XAFT=8.0&END
 &YGRID NYON=20,NYOFF=10,YMAX=2.0&END
 &ZGRID NZ=8,ZP=3.3&END
 &SOLVIN MACH=0.80,AOA=1.2,MAXIT=400,OMEGX=1.92,
         OMEGY=1.92,RCONV=.00001,IPRINT=0,ICIRPF=100,
         OMEGZ=1.92,CON=1.0,NGSEQ=3,BXI=0.0,
         IPLOT=0,IPU=8.OMEGG=1.2,IKLUNK=1,IDESN=0&END
 45X30X16 GRID
 &GPARM IPRNTG=0,WBCPRT=.F.&END
 &XGRID NXON=25,NXFWD=10,NXAFT=10&END
 &YGRID NYON=20.NYOFF=10&END
 &ZGRID NZ=16,ZP=1.75,ZMAX=5.0&END
 &SOLVIN MAXIT=400,OMEGX=1.95,OMEGY=1.95,RCONV=.0001,IPRINT=0,
         ICIRPF=100,OMEGZ=1.95,CON=1.0,BXI=0.0,IVISC=1,
         IPLOT=0,IPU=8,OMEGG=1.2&END
 &VISCDT ITR=10,NVISC=100,NPRV=401,NJPRV=9,RN=8080000.,
         DELCOR=.82139&END
 90X30X30 GRID
 &GPARM IPRNTG=0,WBCPRT=.F.&END
 &XGRID NXON=50,NXFWD=20,NXAFT=20&END
 &YGRID NYON=20,NYOFF=10&END
 &ZGRID NZ=30&END
 &SOLVIN MAXIT=400,OMEGX=1.95,
         OMEGY=1.95,RCONV=.0001,IPRINT=1,ICIRPF=50,
         OMEGZ=1.95,IPLOT=1,IPU=8,OMEGG=1.2,IKLUNK=1,
         BXI=0.0,CON=1.0&END
 &VISCDT ITR=10,NVISC=100,NPRV=400,NJPRV=9&END
```

SAMPLE DATA SET NO. 6
WING C INVISCID ANALYSIS

```
 WING C INVISCID ANALYSIS
 MACH=0.83 AOA=5.0
 WING C ORDINATES
          2         33         33          0
  0.000000  0.002408  0.009607  0.021530  0.038060  0.059039  0.084265  0.113495
  0.146447  0.182803  0.222215  0.264302  0.308658  0.354858  0.402455  0.450991
  0.500000  0.549009  0.597545  0.645142  0.691342  0.735698  0.777785  0.817197
  0.853553  0.886505  0.915735  0.940961  0.961940  0.978470  0.990393  0.997592
  1.000000
  0.000000  0.002408  0.009607  0.021530  0.038060  0.059039  0.084265  0.113495
  0.146447  0.182803  0.222215  0.264302  0.308658  0.354858  0.402455  0.450991
  0.500000  0.549009  0.597545  0.645142  0.691342  0.735698  0.777785  0.817197
  0.853553  0.886505  0.915735  0.940961  0.961940  0.978470  0.990393  0.997592
  1.000000
  0.000000  0.007078  0.015211  0.022409  0.028113  0.032665  0.036344  0.039106
  0.040977  0.042046  0.042446  0.042381  0.041875  0.040963  0.039692  0.038005
  0.036025  0.033750  0.031266  0.028567  0.025780  0.022922  0.020008  0.017060
  0.014113  0.011218  0.008528  0.006165  0.004213  0.002720  0.001669  0.001034
  0.000820
  0.000000 -0.006221 -0.009909 -0.012680 -0.015584 -0.018603 -0.021094 -0.023104
 -0.024642 -0.025693 -0.026348 -0.026447 -0.026081 -0.025220 -0.024010 -0.022330
 -0.020180 -0.017188 -0.013545 -0.009434 -0.005720 -0.002752 -0.000712  0.000412
  0.000767  0.000537  0.000118 -0.000285 -0.000557 -0.000575 -0.000695 -0.000791
 -0.000823
T    F
  0.000000  0.005979  0.014276  0.022373  0.030131  0.037796  0.045339  0.052724
  0.059929  0.066822  0.073148  0.078516  0.082519  0.084923  0.085600  0.084549
  0.081909  0.077914  0.072839  0.066913  0.060301  0.053236  0.046023  0.038892
  0.032028  0.025650  0.019838  0.014702  0.010355  0.006916  0.004546  0.003161
  0.002704
  0.000000 -0.008265 -0.012773 -0.015803 -0.018133 -0.020204 -0.021813 -0.023033
 -0.023855 -0.024169 -0.024120 -0.023592 -0.022620 -0.021102 -0.019120 -0.016540
 -0.013462 -0.009562 -0.005017 -0.000128  0.004105  0.007319  0.009262  0.009845
  0.009212  0.007659  0.005620  0.003410  0.001300 -0.000327 -0.001630 -0.002422
 -0.002681
*** END OF WING C AIRFOIL DATA ***
WINGC PLANFORM DESCRIPTION
0.0       0.0       12.140    10.26000  10.26000  13.90
81.0      8.642     6.367
          1
          2
0.0       0.0       10.260    10.26
```

```
1.0        1.0
          1
          2
0.0        12.14      10.260     13.90
.171539961.171539961
0.0        2.39       1.0        -5.59
 26X30X8 GRID
 &GPARM WBCPRT=.F.,NTIPLE=1&END
 &XGRID XFWD=-5.0,XAFT=8.0,NXON=10,NXFWD=8,NXAFT=8&END
 &YGRID NYON=20,NYOFF=10,YMAX=1.4&END
 &ZGRID NZ=8,ZP=3.3&END
 &SOLVIN MACH=0.83,AOA=5.0,MAXIT=400,OMEGX=1.92,IKLUNK=1,
         OMEGY=1.92,RCONV=.00001,IPRINT=0,ICIRPF=100,
         OMEGZ=1.92,NGSEQ=3,IPLOT=0,IPU=8,OMEGG=1.2&END
 45X30X16 GRID
 &GPARM WBCPRT=.F.&END
 &XGRID NXON=25,NXFWD=10,NXAFT=10&END
 &YGRID NYON=20,NYOFF=10&END
 &ZGRID NZ=16,ZMAX=5.0&END
 &SOLVIN MAXIT=400,OMEGX=1.9,OMEGY=1.9,RCONV=.0001,
         IPRINT=1,ICIRPF=100,OMEGZ=1.9&END
 90X30X30 GRID
 &GPARM IPRNTG=0,WBCPRT=.F.&END
 &XGRID NXON=50,NXFWD=20,NXAFT=20&END
 &YGRID NYON=20,NYOFF=10&END
 &ZGRID NZ=30&END
 &SOLVIN MAXIT=100,OMEGX=1.75,OMEGY=1.75,RCONV=.001,
         IPRINT=1,ICIRPF=50,OMEGZ=1.75,IPLOT=1&END
```

APPENDIX B
SAMPLE OUTPUT

The following pages illustrate the major blocks of data that are printed during the course of an analysis or design run.

TEST CASE DESCRIPTION

M6 VISCOUS INV VISC TARG WITH MODIFIED CPS ΦJ 12 JD 12.12
ZEBIPL5 VERS OF CODE CORRECTED SHAPE DTEW .01 MAXIT 400

*** AIRFOIL ORDINATES INPUT FROM UNIT 5 ***

**** END OF SECTION DATA ****

ONERA M6 PLANFORM DESCRIPTION

YROOT	XLER	XTER	YTIP	XLET	XTET	YMOM
0 0000	0 0000	805 90001196	3000	690 68411143	5999	

SREF	CREF	XMOM
752960 1	646 0700	201 4750

NLES 1

NLEI
2

YLEI	XLEI
0 0000	0 0000
1196 3000	690 6841

DXLER	DXLET
0 577350	0 577350

NTES 1

NTEI
2

YTEI	XTEI
0 0000	805 9000
1196 3000	1143 5999

DXTER	DXTET
0 282971	0 282971

NPAN	INU	INL	KSMTHS
4	69	69	0

N	YP(N)	THETP(N)
1	0 000000	0 000000
2	0 200000	0 000000
3	0 600000	0 000000
4	0 999990	0 000000

PLANFORM INPUT DESCRIPTION

X C AT WHICH UPPER SURFACE ORDINATES ARE INPUT

0.000000 0.000323 0.000551 0.000866 0.001287 0.001836 0.002544 0.003443
0.004570 0.005975 0.007711 0.009841 0.012448 0.015617 0.019461 0.024107
0.029701 0.036426 0.044485 0.054125 0.065630 0.079337 0.095635 0.114980
0.137896 0.164998 0.191933 0.218710 0.245331 0.271798 0.298111 0.324273
0.350283 0.376145 0.401857 0.427422 0.452844 0.478120 0.503251 0.528243
0.553094 0.577804 0.602376 0.626810 0.651109 0.675273 0.699303 0.723199
0.746966 0.770600 0.794106 0.817483 0.840732 0.863856 0.886823 0.906191
0.922534 0.936335 0.947995 0.957851 0.966186 0.973236 0.979202 0.984251
0.988525 0.992144 0.995208 0.997803 1.000000

X C AT WHICH LOWER SURFACE ORDINATES ARE INPUT

0.000000 0.000323 0.000551 0.000866 0.001287 0.001836 0.002544 0.003443
0.004570 0.005975 0.007711 0.009841 0.012448 0.015617 0.019461 0.024107
0.029701 0.036426 0.044485 0.054125 0.065630 0.079337 0.095635 0.114980
0.137896 0.164998 0.191933 0.218710 0.245331 0.271798 0.298111 0.324273
0.350283 0.376145 0.401857 0.427422 0.452844 0.478120 0.503251 0.528243
0.553094 0.577804 0.602376 0.626810 0.651109 0.675273 0.699303 0.723199
0.746966 0.770600 0.794106 0.817483 0.840732 0.863856 0.886823 0.906191
0.922534 0.936335 0.947995 0.957851 0.966186 0.973236 0.979202 0.984251
0.988525 0.992144 0.995208 0.997803 1.000000

Y(N) 0.000000

THE FOLLOWING ZU C ARE INPUT

0.000000 0.003138 0.004096 0.005134 0.006260 0.007478 0.008796 0.010216
0.011742 0.013371 0.015095 0.016898 0.018754 0.020622 0.022455 0.024200
0.025825 0.027332 0.028791 0.030328 0.032014 0.033837 0.035774 0.037792
0.039852 0.041909 0.043621 0.045051 0.046236 0.047199 0.047949 0.048490
0.048818 0.048930 0.048820 0.048483 0.047935 0.047166 0.046190 0.045021
0.043674 0.042168 0.040524 0.038761 0.036899 0.034954 0.032940 0.030866
0.028737 0.026550 0.024303 0.021984 0.019584 0.017091 0.014505 0.012239
0.010273 0.008583 0.007142 0.005922 0.004891 0.004018 0.003280 0.002655
0.002126 0.001678 0.001298 0.000977 0.000705

THE FOLLOWING ZL C ARE INPUT

0.000000 0.003138 0.004096 -0.005134 -0.006260 0.007478 0.008796 0.010216
0.011742 0.013371 0.015095 0.016898 0.018754 0.020622 0.022455 0.024200
0.025825 0.027332 0.028791 0.030328 -0.032014 0.033837 0.035774 -0.037792
0.039852 0.041909 0.043621 0.045051 0.046236 0.047199 0.047949 0.048490
0.048818 0.048930 0.048820 0.048483 0.047935 0.047166 0.046190 0.045021
0.043674 0.042168 0.040524 0.038761 -0.036899 0.034954 0.032940 0.030866
0.028737 -0.026550 0.024303 -0.021984 -0.019584 0.017091 0.014505 -0.012239
0.010273 0.008583 0.007142 0.005922 -0.004891 0.004018 0.003280 0.002655
0.002126 0.001678 0.001298 0.000977 0.000705

AIRFOIL SECTION ORDINATES

COARSE SKEWED MESH

NXON	NXFWD	NXAFT	XPLE	XPTE
10	7	8	0.2000	0.2000

NYON	NYOFF	YPTIP
20	10	1.3000

NZ	ZP
8	3.6550

```
@SOLVIN  MAXIT = 200,  OMEGX = 1.92,  OMEGY = 1.92,  OMEGZ = 1.92,  NI = 90,  NJ = 30,  NK = 30,  RCONV = 1.E-5,  BXI = 0.,
 AOA = 3.06,  MACH = 0.8395,  IPRINT = 0,  IPLOT = 0,  ISDBC = 0,  NDIF = 0,  IFUSE = 0,  NITRL = 100,  SRMAX = 2.1,  BMAX = 2.,
 CON = 1.,  IDESN = 0,  IOPT = 0,  IPRSHP = 0,  IRLOFT = 0,  IVISC = 0,  ICPSDC = 0,  OMEGG = 1.2,  ICIRPF = 100,  IKLUNK = 1,
 NGSEQ = 3,  IPU = 8,  NITRF = 10,  ILED = 0,  ITED = 0,  NITDSN = 0,  ISVSHP = 0,  IINV = 0,  IRSTRT = 0,  NF = 30,  NJSHP = 5,
 ISRLOR = 0,  IPSHPF = 100,  @END
```

INPUT REQUIRED 0.0227 CPU SECONDS

```
XPLE = 1.860148 XPTE = 1.585522
 YP = 1.241288
```


MESH GENERATION DATA

WING DESCRIPTION

L E SWEEP	T E SWEEP	ROOT CHORD	TIP CHORD	WING AREA.	ASPECT RATIO	TAPER RATIO	REF CHORD
0 5774	0 2823	1 0000	0 5620	1 159	3 8014	0 5620	0 8017

WING LEADING AND TRAILING EDGE COORDINATES

K	ETA	XLEW	XTEW
NOMINAL WING ROOT			
1	0.000000	0 000000	1 000000
2	0 076124	0 043950	1.021533
3	0 152249	0 087901	1 043052
4	0 228373	0 131851	1.064558
5	0.304498	0 175802	1 086054
6	0.380622	0 219752	1 107539
7	0 456747	0 263703	1 129017
8	0 532871	0.307653	1.150489
9	0.608996	0.351604	1.171956
10	0 685120	0 395554	1.193420
11	0.761245	0.439505	1.214883
12	0 837369	0 483455	1 236346
13	0 913494	0.527406	1.257812
14	0 989618	0 571356	1.279281
15	1 065743	0 615307	1.300756
16	1 141867	0 659257	1 322237
17	1 217992	0 703208	1 343727
18	1 294116	0.747158	1.365228
19	1 370241	0 791109	1.386740
20	1 446365	0 835059	1.408266

XI 0 AND XI 1 COORDINATES AND SLOPES

K	ETA	XLE	XTE	XLEP	XTEP
NOMINAL WING ROOT					
1	0.000000	0 000000	1 000000	0 577350	0.282971
2	0 076124	0 043950	1.021533	0 577350	0.282772
3	0 152249	0 087901	1 043052	0 577350	0.282593
4	0 228373	0 131851	1.064558	0 577350	0 282437
5	0 304498	0 175802	1 086054	0 577350	0.282302
6	0 380622	0 219752	1 107539	0 577350	0 282188
7	0 456747	0 263703	1 129017	0 577350	0.282097
8	0 532871	0 307653	1 150489	0.577350	0.282026
9	0 608996	0 351604	1 171956	0 577350	0 281978
10	0.685120	0.395554	1.193420	0 577350	0.281951
11	0.761245	0.439505	1.214883	0 577350	0 281945
12	0 837369	0 483455	1.236346	0 577350	0 281962
13	0 913494	0.527406	1.257812	0 577350	0.281999
14	0 989618	0.571356	1.279281	0 577350	0.282059
15	1 065743	0 615307	1.300756	0 577350	0.282140
16	1 141867	0.659257	1.322237	0 577350	0.282242
17	1.217992	0.703208	1 343727	0 577350	0.282367
18	1 294116	0 747158	1.365228	0.577350	0.282512
19	1.370241	0.791109	1.386740	0 577350	0.282680

COMPUTED PLANFORM DATA

20	1.446365	0.835059	1.408266	0.577350	0.282869	
NOMINAL WING TIP						
21	1.522490	0.879010	1.429805	0.577350	0.282971	
22	1.598614	0.922960	1.473756	0.577350	0.577350	
23	1.693106	0.977515	1.528311	0.577350	0.577350	
24	1.810398	1.045234	1.596029	0.577350	0.577350	
25	1.955991	1.129292	1.680087	0.577350	0.577350	
26	2.136714	1.233632	1.784427	0.577350	0.577350	
27	2.361042	1.363148	1.913943	0.577350	0.577350	
28	2.639498	1.523915	2.074710	0.577350	0.577350	
29	2.985141	1.723472	2.274267	0.577350	0.577350	
30	3.414183	1.971179	2.521975	0.577350	0.577350	

J INDEX OF LEADING AND TRAILING EDGE POINTS AND DX C

K	ETA	JLE	JTE	(X XLEW) C	(X XTEW) C
NOMINAL WING ROOT					
1	0.000000	8	17	0.052632	1.000000
2	0.076124	8	17	0.052632	1.000000
3	0.152249	8	17	0.052632	1.000000
4	0.228373	8	17	0.052632	1.000000
5	0.304498	8	17	0.052632	1.000000
6	0.380622	8	17	0.052632	1.000000
7	0.456747	8	17	0.052632	1.000000
8	0.532871	8	17	0.052632	1.000000
9	0.608996	8	17	0.052632	1.000000
10	0.685120	8	17	0.052632	1.000000
11	0.761245	8	17	0.052632	1.000000
12	0.837369	8	17	0.052632	1.000000
13	0.913494	8	17	0.052632	1.000000
14	0.989618	8	17	0.052632	1.000000
15	1.065743	8	17	0.052632	1.000000
16	1.141867	8	17	0.052632	1.000000
17	1.217992	8	17	0.052632	1.000000
18	1.294116	8	17	0.052632	1.000000
19	1.370241	8	17	0.052632	1.000000
20	1.446365	8	17	0.052632	1.000000

MESH GENERATION REQUIRED 0.11502 CPU SECONDS

NI	NJ	NK	KUP	ILE	ITE	JTIP
25	30	8	5	8	17	21

RHOINF	QINF
0.71917	0.86095

INITIALIZATION REQUIRED 0.0016 CPU SECONDS

NIT	ICMAX	JCMAX	KCMAX	CMAX	IRMAX	JRMAX	KRMAX	RMAX	NSP	CLG	RAVG
1	17	1	5	0.82328E 02	17	1	5	0.17664E+01	0	0.00000E+00	0.11191E-01
2	17	1	5	0.11550E 01	17	1	5	0.25099E+01	0	0.13639E 01	0.10650E 01
3	18	2	5	0.11583E 01	18	2	5	0.23272E+01	0	0.37289E 01	0.16444E 01
4	19	2	5	0.11189E 01	19	2	5	0.19090E+01	0	0.56933E 01	0.18153E 01
5	19	4	5	0.71022E 02	17	4	5	0.13710E+01	0	0.73427E 01	0.17794E 01
6	16	8	5	0.49156E 02	17	6	5	0.10555E+01	0	0.88428E 01	0.16919E 01
7	16	8	5	0.40189E 02	16	8	5	0.83312E+00	0	0.96458E 01	0.15712E 01
8	21	9	5	0.41465E 02	15	10	5	0.69460E+00	0	0.10442E+00	0.14578E 01
9	20	3	6	0.39641E 02	15	10	5	0.59061E+00	0	0.11054E+00	0.13750E 01
10	21	1	6	0.36226E 02	17	7	6	0.52704E+00	0	0.11580E+00	0.13494E 01
11	21	3	6	0.34110E 02	17	9	6	0.50970E+00	0	0.12111E+00	0.13695E 01
12	21	3	6	0.28202E 02	17	9	6	0.48117E+00	0	0.12646E+00	0.14112E 01
13	21	3	5	0.32721E 02	21	3	5	0.49367E+00	0	0.13163E+00	0.14413E 01
14	21	4	5	0.26567E 02	16	9	6	0.40307E+00	0	0.13670E+00	0.14810E 01
15	16	11	6	0.19872E 02	16	9	6	0.37850E+00	0	0.14183E+00	0.15202E 01
16	15	11	6	0.18454E 02	17	3	5	0.36654E+00	0	0.14704E+00	0.15552E 01
17	22	5	5	0.25184E 02	22	5	5	0.37184E+00	2	0.15225E+00	0.15805E 01
18	22	2	5	0.25922E 02	22	2	5	0.38639E+00	5	0.15735E+00	0.15982E 01
19	17	2	5	0.15576E-02	17	2	5	0.35076E+00	14	0.16226E+00	0.16316E 01
20	16	4	5	0.15122E 02	17	2	5	0.33878E+00	21	0.16697E+00	0.16925E 01
21	16	4	5	0.14787E-02	17	2	5	0.32403E+00	28	0.17151E+00	0.17717E 01
22	22	2	4	0.18916E 02	17	2	5	0.30584E+00	35	0.17587E+00	0.18539E-01
23	24	3	4	0.16307E 02	16	2	5	0.29218E+00	37	0.17994E+00	0.19428E-01
24	15	6	5	0.13613E 02	15	6	5	0.27814E+00	42	0.18371E+00	0.20352E 01
25	14	8	5	0.13361E 02	15	6	5	0.26628E+00	43	0.18720E+00	0.21213E-01
26	22	1	5	0.13043E 02	14	8	5	0.25555E+00	47	0.19046E+00	0.21832E 01
27	22	2	5	0.14550E 02	14	8	5	0.24555E+00	49	0.19349E+00	0.22165E 01
28	13	12	5	0.11998E 02	14	8	5	0.23364E+00	54	0.19625E+00	0.22250E-01
29	13	12	5	0.11477E 02	14	8	5	0.22114E+00	55	0.19875E+00	0.22133E-01
30	13	12	5	0.10906E 02	14	6	5	0.20949E+00	57	0.20106E+00	0.21793E 01
31	13	10	5	0.10348E 02	14	6	5	0.19761E+00	60	0.20319E+00	0.21257E-01
32	13	10	5	0.98559E 03	14	4	5	0.18647E+00	60	0.20516E+00	0.20597E-01
33	13	10	5	0.93741E 03	13	10	5	0.17718E+00	60	0.20695E+00	0.19898E-01
34	13	10	5	0.88986E 03	13	10	5	0.16825E+00	61	0.20860E+00	0.19199E-01
35	13	10	5	0.84269E 03	13	10	5	0.15943E+00	62	0.21015E+00	0.18471E 01
36	13	8	5	0.80066E 03	13	8	5	0.15081E+00	62	0.21160E+00	0.17711E 01
37	13	8	5	0.76280E 03	14	2	5	0.14395E+00	62	0.21296E+00	0.16952E-01
38	13	8	5	0.72497E 03	14	2	5	0.13753E+00	63	0.21424E+00	0.16195E-01
39	13	8	5	0.68784E 03	14	2	5	0.13113E+00	63	0.21545E+00	0.15420E 01
40	13	6	5	0.65276E 03	14	2	5	0.12473E+00	62	0.21661E+00	0.14614E 01
41	13	6	5	0.62291E 03	14	2	5	0.11837E+00	62	0.21771E+00	0.13796E 01
42	13	6	5	0.59298E 03	14	2	5	0.11215E+00	64	0.21877E+00	0.13000E 01
43	13	6	5	0.56300E-03	14	2	5	0.10613E+00	62	0.21978E+00	0.12243E-01
44	13	6	5	0.53342E-03	13	6	5	0.10045E+00	64	0.22073E+00	0.11525E 01
45	13	6	5	0.50441E 03	13	6	5	0.95024E 01	65	0.22165E+00	0.10851E 01
46	13	4	5	0.47925E 03	13	4	5	0.90282E-01	64	0.22252E+00	0.10234E 01
47	13	4	5	0.45563E-03	13	4	5	0.85837E-01	64	0.22335E+00	0.96775E-02
48	13	4	5	0.43239E 03	13	4	5	0.81466E 01	65	0.22413E+00	0.91721E 02
49	13	4	5	0.40948E 03	13	4	5	0.77159E-01	66	0.22486E+00	0.86941E 02
50	13	4	5	0.38680E 03	13	4	5	0.72900E 01	65	0.22556E+00	0.82378E 02
51	13	4	5	0.36450E 03	13	2	5	0.68741E-01	66	0.22620E+00	0.78048E 02
52	13	2	5	0.34414E-03	13	2	5	0.65095E 01	67	0.22680E+00	0.73918E 02
53	13	2	5	0.32527E-03	13	2	5	0.61525E-01	67	0.22736E+00	0.69905E 02

POTENTIAL FLOW SOLVER CONVERGENCE INFORMATION

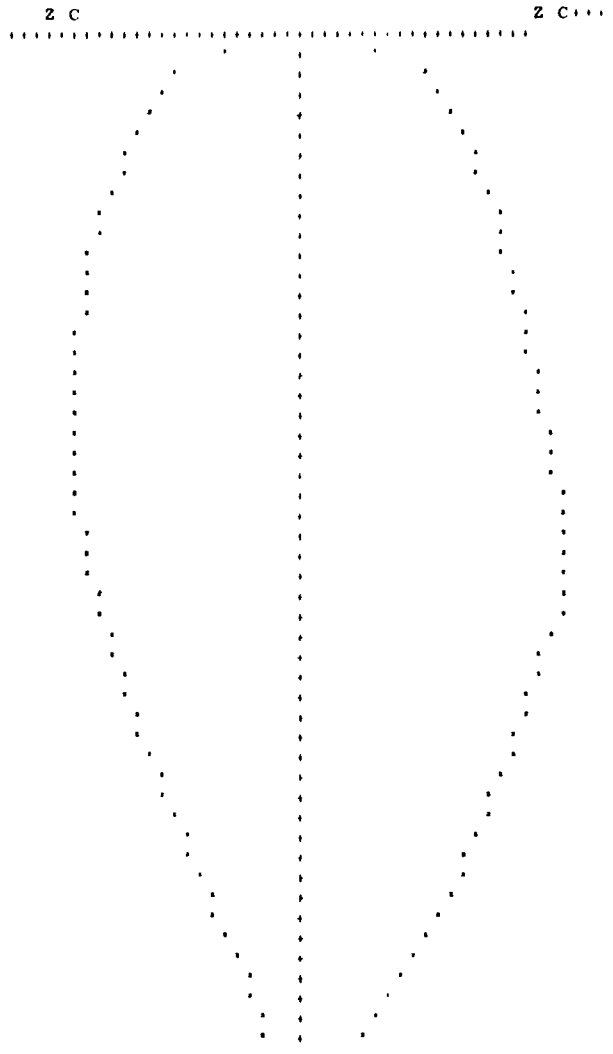
BOUNDARY LAYER ANALYSIS FOR REYNOLDS NO OF 0 205E+08

X	Z	ZNEW	M	DELS	THETA	SEP	H	PI	IND	TAU
0 07071	0 03271	0 03277	1 30845	0 00001	0 00001	0 00007	1 04530	0 16684	13	0 00186
0 09091	0 03524	0 03535	1 17606	0 00012	0 00006	0 00013	2 01341	0 13480	12	0 00161
0 11111	0 03741	0 03759	1 13413	0 00019	0 00010	0 00005	1 90857	0 02334	11	0 00154
0 13131	0 03929	0 03953	1 13903	0 00024	0 00013	0 00004	1 87177	0 06475	11	0 00148
0 15152	0 04093	0 04122	1 14959	0 00029	0 00016	0 00005	1 86620	0 05075	11	0 00143
0 17172	0 04236	0 04271	1 15635	0 00034	0 00018	0 00003	1 86617	0 03483	11	0 00138
0 19192	0 04362	0 04401	1 16024	0 00039	0 00021	0 00002	1 86456	-0 03207	11	0 00134
0 21212	0 04472	0 04516	1 16334	0 00044	0 00024	0 00003	1 86153	0 04057	10	0 00132
0 23232	0 04568	0 04617	1 16680	0 00048	0 00026	0 00003	1 85837	0 05684	10	0 00130
0 25253	0 04652	0 04705	1 17118	0 00053	0 00029	0 00005	1 85592	0 07727	10	0 00128
0 27273	0 04723	0 04780	1 17661	0 00057	0 00031	0 00006	1 85469	0 09782	10	0 00126
0 29293	0 04782	0 04843	1 18298	0 00061	0 00033	0 00007	1 85476	0 11918	10	0 00125
0 31313	0 04828	0 04894	1 19023	0 00065	0 00035	0 00009	1 85608	0 13871	10	0 00124
0 33333	0 04863	0 04932	1 19816	0 00069	0 00037	0 00010	1 85877	0 15337	10	0 00123
0 35354	0 04884	0 04957	1 20647	0 00073	0 00039	0 00011	1 86245	0 16818	10	0 00122
0 37374	0 04893	0 04970	1 21513	0 00077	0 00041	0 00011	1 86724	0 17265	10	0 00121
0 39394	0 04888	0 04969	1 22360	0 00081	0 00043	0 00010	1 87474	0 14048	10	0 00119
0 41414	0 04868	0 04954	1 23011	0 00085	0 00045	0 00007	1 88489	0 07593	10	0 00116
0 43434	0 04835	0 04926	1 23340	0 00089	0 00047	0 00002	1 89619	0 02778	10	0 00113
0 45455	0 04789	0 04887	1 23228	0 00095	0 00050	0 00007	1 90983	0 21881	10	0 00109
0 47475	0 04728	0 04838	1 22439	0 00101	0 00052	0 00025	1 93689	0 75195	10	0 00100
0 49495	0 04653	0 04783	1 20191	0 00115	0 00056	0 00081	2 04031	3 53550	13	0 00074
0 51515	0 04566	0 04721	1 14015	0 00154	0 00065	0 00195	2 38170	25 57653	38	0 00027
0 53535	0 04465	0 04644	1 04230	0 00202	0 00084	0 00234	2 41017	8 54940	17	0 00052
0 55556	0 04353	0 04547	0 98706	0 00190	0 00098	0 00114	1 94222	0 44129	14	0 00099
0 57576	0 04230	0 04430	0 98095	0 00174	0 00101	0 00034	1 71521	0 79443	7	0 00094
0 59596	0 04097	0 04299	0 97114	0 00184	0 00106	0 00055	1 74422	1 33751	10	0 00087
0 61616	0 03954	0 04159	0 95696	0 00195	0 00111	0 00069	1 75935	1 46372	11	0 00086
0 63636	0 03804	0 04013	0 94275	0 00205	0 00117	0 00071	1 75054	1 43767	11	0 00086
0 65657	0 03647	0 03862	0 92963	0 00213	0 00123	0 00071	1 73777	1 43954	11	0 00085
0 67677	0 03483	0 03707	0 91731	0 00222	0 00129	0 00072	1 72926	1 50647	11	0 00084
0 69697	0 03314	0 03547	0 90529	0 00232	0 00135	0 00075	1 72479	1 60696	11	0 00083
0 71717	0 03139	0 03384	0 89341	0 00243	0 00141	0 00079	1 72224	1 72473	11	0 00081
0 73737	0 02960	0 03218	0 88161	0 00254	0 00147	0 00085	1 72238	1 90457	11	0 00080
0 75758	0 02776	0 03045	0 86965	0 00266	0 00154	0 00092	1 72534	2 11718	11	0 00078
0 77778	0 02587	0 02870	0 85751	0 00279	0 00162	0 00099	1 72897	2 33511	11	0 00076
0 79798	0 02392	0 02692	0 84529	0 00294	0 00169	0 00108	1 73695	2 71361	11	0 00073
0 81818	0 02191	0 02511	0 83259	0 00313	0 00178	0 00124	1 76052	3 54300	12	0 00068
0 83838	0 01983	0 02327	0 81851	0 00339	0 00188	0 00150	1 80529	4 94413	13	0 00061
0 85859	0 01767	0 02140	0 80273	0 00368	0 00200	0 00172	1 84542	5 87518	13	0 00057
0 87879	0 01542	0 01954	0 78685	0 00394	0 00213	0 00181	1 85461	6 03249	12	0 00056
0 89899	0 01309	0 01773	0 77203	0 00429	0 00226	0 00203	1 90099	9 40472	18	0 00048
0 91919	0 01068	0 01596	0 75551	0 00534	0 00242	0 00275	2 20735	54 92064	55	0 00015
0 93939	0 00821	0 01423	0 73394	0 00621	0 00268	0 00307	2 31573	22 15929	29	0 00028
0 95960	0 00571	0 01268	0 71711	0 00555	0 00290	0 00205	1 91248	2 96701	11	0 00068
0 97980	0 00321	0 01156	0 71048	0 00733	0 00299	0 00265	2 44948	**********	51	0 00000
1 00000	0 00070	0 01045	0 69042	0 01012	0 00339	0 00552	2 98649	**********	51	0 00000

BOUNDARY LAYER ANALYSIS INFORMATION

INVERSE SHAPE AT J = 12

I	X C	ZU	ZL
1	0 01010	0 01710	0 01710
2	0 03030	0 02598	0 02598
3	0 05051	0 02977	0 02977
4	0 07071	0 03246	0 03265
5	0 09091	0 03508	0 03527
6	0 11111	0 03748	0 03759
7	0 13131	0 03934	0 03951
8	0 15152	0 04091	0 04117
9	0 17172	0 04235	0 04265
10	0 19192	0 04363	0 04396
11	0 21212	0 04481	0 04510
12	0 23232	0 04595	0 04610
13	0 25253	0 04700	0 04697
14	0 27273	0 04802	0 04772
15	0 29293	0 04900	0 04834
16	0 31313	0 04995	0 04884
17	0 33333	0 05089	0 04922
18	0 35354	0 05182	0 04947
19	0 37374	0 05275	0 04960
20	0 39394	0 05369	0 04958
21	0 41414	0 05466	0 04943
22	0 43434	0 05566	0 04914
23	0 45455	0 05669	0 04872
24	0 47475	0 05766	0 04815
25	0 49495	0 05839	0 04745
26	0 51515	0 05864	0 04663
27	0 53535	0 05829	0 04568
28	0 55556	0 05744	0 04461
29	0 57576	0 05618	0 04344
30	0 59596	0 05463	0 04217
31	0 61616	0 05305	0 04081
32	0 63636	0 05158	0 03937
33	0 65657	0 05014	0 03786
34	0 67677	0 04867	0 03629
35	0 69697	0 04715	0 03467
36	0 71717	0 04557	0 03300
37	0 73737	0 04392	0 03128
38	0 75758	0 04219	0 02951
39	0 77778	0 04037	0 02771
40	0 79798	0 03845	0 02586
41	0 81818	0 03641	0 02396
42	0 83838	0 03424	0 02201
43	0 85859	0 03192	0 02003
44	0 87879	0 02944	0 01801
45	0 89899	0 02681	0 01597
46	0 91919	0 02405	0 01391
47	0 93939	0 02117	0 01192
48	0 95960	0 01825	0 01020
49	0 97980	0 01534	0 00891
50	1 00000	0 01275	0 00762



INVERSE AIRFOIL PRINTER PLOT

*** PLOT OF NEW ORDINATES AFTER B L CALCULATION AND SMOOTHING **

I	X C	ZU	ZL
1	0.01010	0.01710	0.01710
2	0.03030	0.02598	0.02598
3	0.05051	0.02977	0.02977
4	0.07071	0.03277	0.03276
5	0.09091	0.03535	0.03533
6	0.11111	0.03759	0.03755
7	0.13131	0.03953	0.03949
8	0.15152	0.04122	0.04117
9	0.17172	0.04271	0.04265
10	0.19192	0.04401	0.04395
11	0.21212	0.04516	0.04509
12	0.23232	0.04617	0.04609
13	0.25253	0.04705	0.04696
14	0.27273	0.04780	0.04771
15	0.29293	0.04843	0.04833
16	0.31313	0.04894	0.04883
17	0.33333	0.04932	0.04921
18	0.35354	0.04957	0.04946
19	0.37374	0.04970	0.04958
20	0.39394	0.04969	0.04957
21	0.41414	0.04954	0.04941
22	0.43434	0.04926	0.04912
23	0.45455	0.04887	0.04870
24	0.47475	0.04838	-0.04814
25	0.49495	0.04783	0.04744
26	0.51515	0.04721	-0.04661
27	0.53535	0.04644	-0.04566
28	0.55556	0.04547	0.04459
29	0.57576	0.04430	-0.04342
30	0.59596	0.04299	-0.04214
31	0.61616	0.04159	-0.04078
32	0.63636	0.04013	-0.03934
33	0.65657	0.03862	0.03783
34	0.67677	0.03707	0.03626
35	0.69697	0.03547	0.03463
36	0.71717	0.03384	0.03296
37	0.73737	0.03216	0.03123
38	0.75758	0.03045	0.02947
39	0.77778	0.02870	-0.02765
40	0.79798	0.02692	-0.02579
41	0.81818	0.02511	0.02388
42	0.83838	0.02327	-0.02191
43	0.85859	0.02140	-0.01990
44	0.87879	0.01954	-0.01783
45	0.89899	0.01773	-0.01573
46	0.91919	0.01596	0.01359
47	0.93939	0.01423	-0.01147
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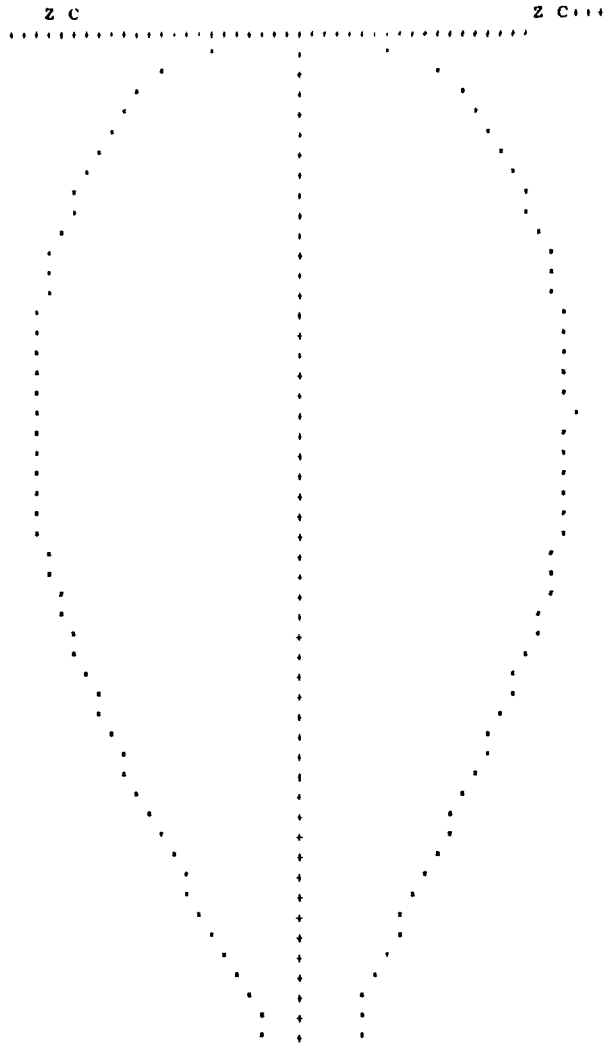
49	0.97980	0.01156	-0.00774
50	1.00000	0.01045	-0.00600



VISCOUS AIRFOIL PRINTER PLOT

SPAN STATION ETA 0 154
CLS 0 23271 CDS 0.00817 CMS 0.03419

I	X C	CPU	CPL	RHOU	RHOL	MACHU	MACHL
1	0 01010	0 35162	0 41652	0 62767	0 82187	1 01187	0 63886
2	0 03030	0.74415	0 14369	0 51871	0 75523	1 22528	0 77086
3	0 05051	0 56910	0 08695	0 56833	0 74107	1 12606	0 79794
4	0 07071	0 43701	0.06451	0 60465	0 73545	1 05574	0 80865
5	0 09091	0 40424	0 03568	0 61353	0 72819	1 03878	0 82243
6	0 11111	0 40684	0 01036	0 61282	0 72179	1 04012	0 83454
7	0 13131	0 41089	0 01145	0 61173	0 71627	1 04221	0 84499
8	0 15152	0 41302	0 02985	0 61115	0 71159	1 04331	0 85381
9	0 17172	0 41497	0 04606	0 61063	0 70746	1 04432	0 86160
10	0 19192	0 41794	0 06110	0 60982	0 70362	1 04585	0 86883
11	0 21212	0 42281	0 07583	0 60850	0 69985	1 04837	0 87592
12	0 23232	0 42959	0 09055	0 60666	0 69607	1 05189	0 88302
13	0 25253	0 43831	0 10548	0 60430	0 69224	1 05642	0 89024
14	0 27273	0 44890	0 12071	0 60142	0 68831	1 06195	0 89762
15	0 29293	0 46113	0 13613	0 59809	0 68433	1 06834	0 90510
16	0 31313	-0 47493	0 15170	0 59432	0 68030	1 07560	0 91267
17	0 33333	0 49000	0 16713	0 59019	0 67630	1 08356	0 92019
18	0 35354	0 50587	0 18199	0 58583	0 67243	1 09199	0 92745
19	0 37374	0 52259	0 19619	0 58122	0 66873	1 10092	0 93441
20	0 39394	0 53949	0 20892	0 57655	0 66541	1 11000	0 94066
21	0 41414	-0 55500	0 21904	0 57225	0 66276	1 11839	0 94564
22	0 43434	-0 56984	0 22739	0 56812	0 66057	1 12646	0 94975
23	0 45455	-0 58485	0 23400	0 56394	0 65884	1 13468	0 95302
24	0 47475	-0 59816	0 23694	0 56021	0 65807	1 14200	0 95447
25	0 49495	-0 60856	0 23631	0 55730	0 65823	1 14776	0 95416
26	0 51515	0 61494	0 23286	0 55551	0 65914	1 15130	0 95245
27	0 53535	0 61482	0 22644	0 55554	0 66082	1 15123	0 94929
28	0 55556	0 60772	0 21723	0 55753	0 66324	1 14729	0 94474
29	0 57576	0 59133	0 20574	0 56213	0 66624	1 13824	0 93910
30	0 59596	0 53763	0 19266	0 57707	0 66965	1 10900	0 93268
31	0 61616	0 40489	0 17835	0 61335	0 67338	1 03912	0 92567
32	0 63636	0 26952	0 16325	0 64949	0 67731	0 97063	0 91830
33	0 65657	0 21172	0 14780	0 66468	0 68131	0 94204	0 91077
34	0 67677	0 18486	0 13220	0 67169	0 68535	0 92886	0 90319
35	0 69697	0 15647	0 11660	0 67906	0 68937	0 91499	0 89563
36	0 71717	0 12879	0 10114	0 68623	0 69335	0 90153	0 88814
37	0 73737	0 10364	0 08579	0 69271	0 69729	0 88935	0 88073
38	0 75758	0 08060	0 07015	0 69863	0 70130	0 87822	0 87319
39	0 77778	0 05859	0 05402	0 70426	0 70543	0 86762	0 86542
40	0 79798	0 03662	0 03715	0 70987	0 70973	0 85706	0 85731
41	0 81818	0 01338	0 01868	0 71578	0 71443	0 84591	0 84845
42	0 83838	0 01285	0 00202	0 72242	0 71968	0 83335	0 83853
43	0 85859	0 04270	0 02501	0 72996	0 72550	0 81907	0 82753
44	0 87879	0 07298	0 05019	0 73757	0 73185	0 80461	0 81549
45	0 89899	0 10094	0 07920	0 74457	0 73913	0 79126	0 80164
46	0 91919	0 13141	0 11469	0 75217	0 74801	0 77672	0 78470
47	0 93939	0 17135	0 15520	0 76209	0 75809	0 75764	0 76535
48	0 95960	0 20276	0 18597	0 76985	0 76570	0 74261	0 75065
49	0 97980	0 21466	0 20521	0 77278	0 77045	0 73690	0 74144
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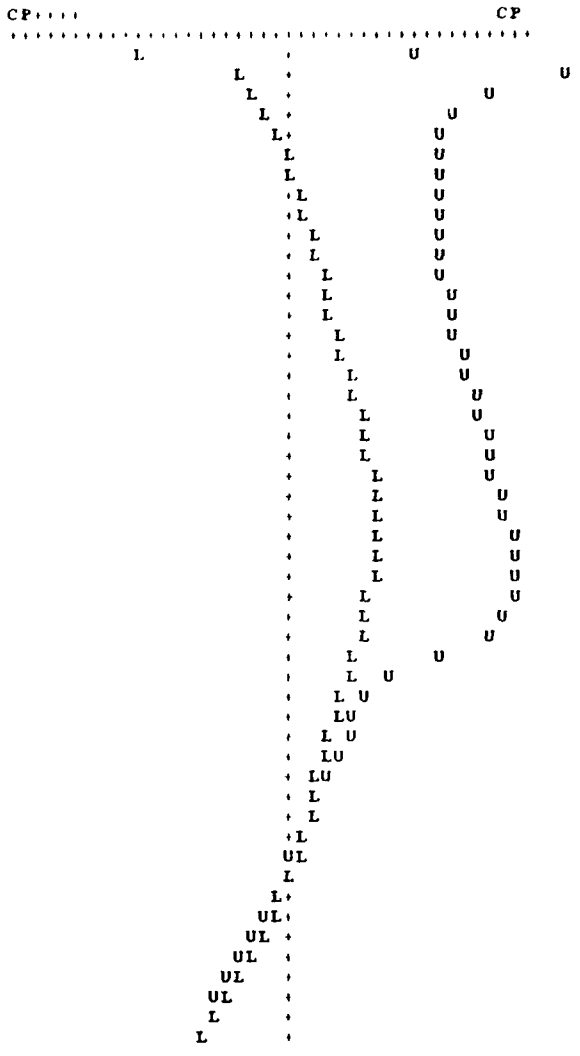

WING SECTION PRESSURE COEFFICIENT PRINTER PLOT AND DATA TABULATION

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